SITE-SPECIFIC UFP QUALITY ASSURANCE PROJECT PLAN

MAGNA METALS SITE

Cortlandt, Westchester County, New York

SSID No: A28A

DC No: RST3-04-D-0147
TDD No: TO-0010-0146
EPA Contract No: EP-S2-14-01

Prepared for:

U.S. Environmental Protection Agency
Region II – Removal Action Branch
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Edison, New Jersey 08837

Prepared by:

Removal Support Team 3
Weston Solutions, Inc.
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Edison, New Jersey 08837

March 2018

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LIST OF ATTACHMENTS

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Attachment B: **Sampling Standard Operating Procedures**

LIST OF ACRONYMS

ADR	Automated Data Review
ANSETS	Analytical Services Tracking System
AOC	Acknowledgment of Completion
ASTM	American Society for Testing and Materials
CEO	Chief Executive Officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CFM	Contract Financial Manager
CO	Contract Officer
COI	Conflict of Interest
COO	Chief Operations Officer
CRDL	Contract Required Detection Limit
CRTL	Core Response Team Leader
CRQL	Contract Required Quantitation Limit
CQLOSS	Corporate Quality Leadership and Operations Support Services
CWA	Clean Water Act
DCN	Document Control Number
DESA	Division of Environmental Science and Assessment
DI	Deionized Water
DPO	Deputy Project Officer
DQI	Data Quality Indicator
DQO	Data Quality Objective
EM	Equipment Manager
EDD	Electronic Data deliverable
ENVL	Environmental Unit Leader
EPA	Environmental Protection Agency
ERT	Environmental Response Team
FASTAC	Field and Analytical Services Teaming Advisory Committee
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
HASP	Health and Safety Plan
HRS	Hazard Ranking System
HSO	Health and Safety Officer
ITM	Information Technology Manager
LEL	Lower Explosive Limit
MSA	Mine Safety Appliances
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response

LIST OF ACRONYMS (Concluded)

PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, Sensitivity
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PIO	Public Information Officer
PM	Program Manager
PO	Project Officer
PRP	Potentially Responsible Party
PT	Proficiency Testing
QA	Quality Assurance
QAL	Quality Assurance Leader
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RC	Readiness Coordinator
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RSCC	Regional Sample Control Coordinator
RST	Removal Support Team
SARA	Superfund Amendments and Reauthorization Act
SEDD	Staged Electronic Data Deliverable
SOP	Standard Operating Practice
SOW	Statement of Work
SPM	Site Project Manager
START	Superfund Technical Assessment and Response Team
STR	Sampling Trip Report
TAL	Target Analyte List
TCL	Total Compound List
TDD	Technical Direction Document
TDL	Technical Direction Letter
TO	Task Order
TQM	Total Quality Management
TSCA	Toxic Substances Control Act
UFP	Uniform Federal Policy
VOA	Volatile Organic Analysis

CROSSWALK

The following table provides a “cross-walk” between the QAPP elements outlined in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP Manual), the necessary information, and the location of the information within the text document and corresponding QAPP Worksheet. Any QAPP elements and required information that are not applicable to the project are circled.

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Section	Crosswalk to QAPP Worksheet No.
Project Management and Objectives			
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2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	1	 9 10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria	3	11 12

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5.1 Overview			
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QAPP Worksheet #1: Title and Approval Page

Title: Site-Specific Quality Assurance Project Plan
Site Name/Project Name: Magna Metals Site
Site Location: 510 Furnace Dock Road, Westchester County, New York
Revision Number: 00
Revision Date: Not Applicable

Weston Solutions, Inc.
Lead Organization

Michael Garibaldi
Weston Solutions, Inc.
1090 King Georges Post Road, Suite 201
Edison, NJ 08837
Email: Michael.Garibaldi@WestonSolutions.com
Preparer's Name and Organizational Affiliation

30 March 2018
Preparation Date (Day/Month/Year)

Site Project Manager: ______________________
Signature

Michael Garibaldi/Weston Solutions, Inc.
Printed Name/Organization/Date

QA Officer/Technical Reviewer: ______________________
Signature

Smita Sumbaly/Weston Solutions, Inc.
Printed Name/Organization/Date

EPA, Region II On-Scene Coordinator (OSC): ______________________
Signature

Joel Petty/EPA, Region II
Printed Name/Organization/Date

EPA, Region II Quality Assurance Officer (QAO): ______________________
Signature

Printed Name/Organization/Date

Document Control Number: RST3-04-D-0147

QAPP Worksheet #2: QAPP Identifying Information

Site Name/Project Name: Magna Metals Site
Site Location: 510 Furnace Dock Road, Cortlandt, Westchester County, New York
Operable Unit: 00
Title: Site-Specific Quality Assurance Project Plan
Revision Number: 00
Revision Date: Not Applicable

1. **Identify guidance used to prepare QAPP:** Uniform Federal Policy for Quality Assurance Project Plans. Refer to EPA Method TO-15 and CLP Method SOM02.4
2. **Identify regulatory program:** EPA, Region II
3. **Identify approval entity:** EPA, Region II
4. **Indicate whether the QAPP is a generic or a <u>Site-specific</u> QAPP.**
5. **List dates of scoping sessions that were held:** March 14, 2018
6. **List dates and titles of QAPP documents written for previous site work, if applicable:**

   None

7. **List organizational partners (stakeholders) and connection with lead organization:**

   None

8. **List data users:**

   EPA, Region II (See Worksheet # 4 for individuals)

9. **If any required QAPP elements and required information are not applicable to the project, then provide an explanation for their exclusion below:**

   Not applicable

10. **Document Control Number:** RST3-04-D-0147

QAPP Worksheet #3: Distribution List

[List those entities to which copies of the approved QAPP, subsequent QAPP revisions, addenda, and amendments are sent]

QAPP Recipient	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Joel Petty	OSC	EPA, Region II	(732) 321-4388	(732) 906-6182	Petty.Joel@epa.gov	RST3-04-D-0147
Bernard Nwosu	HSO	Weston Solutions, Inc., RST 3	(732) 585-4413	(732) 225-7037	Ben.Nwosu@westonsolutions.com	RST3-04-D-0147
Smita Sumbaly	QA Officer	Weston Solutions, Inc., RST 3	(732) 585-4410	(732) 225-7037	S.Sumbaly@westonsolutions.com	RST3-04-D-0147
Michael Garibaldi	SPM	Weston Solutions, Inc., RST 3	(732) 585-4419	(732) 225-7037	Michael.Garibaldi@westonsolutions.com	RST3-04-D-0147
Site TDD File	RST 3 Site TDD File	Weston Solutions, Inc., RST 3	Not Applicable	Not Applicable	Not Applicable	-

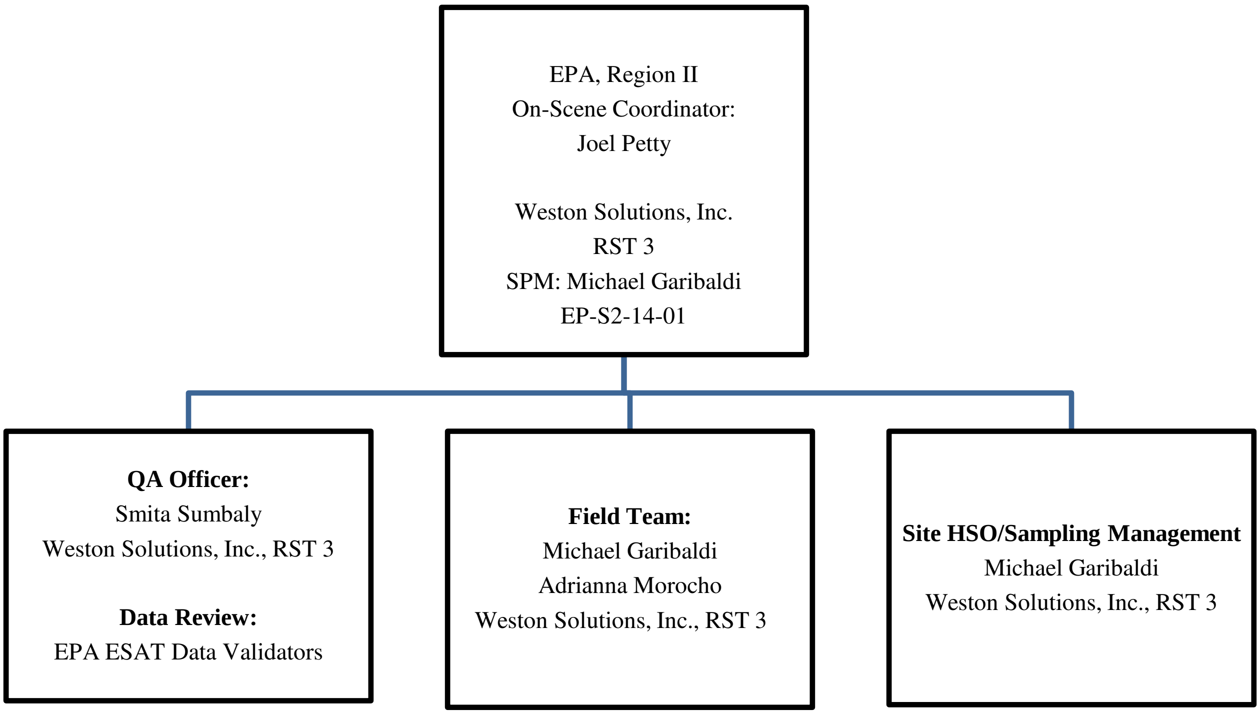
QAPP Worksheet #4: Project Personnel Sign-Off Sheet

Organization: Weston Solutions, Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Joel Petty	EPA, Region II, On-Scene Coordinator	(732) 321-4388		
Michael Garibaldi	Site Project Manager, RST 3	(732) 585-4419	Michael Garibaldi	3/30/2018
Bernard Nwosu	HSO, RST 3	(732) 585-4413	Bernard Nwosu	3/30/18
Smita Sumbaly	QA Officer, RST 3	(732) 585-4410	Smita Sumbaly	3/30/18
Adrianna Morocho	Field Personnel, RST 3	(732) 585-4449	[illegible]	3/30/18

QAPP Worksheet #5: Project Organizational Chart

Identify reporting relationship between all organizations involved in the project, including the lead organization and all contractor and subcontractor organizations. Identify the organizations providing field sampling, on-site and off-site analysis, and data review services, including the names and telephone numbers of all project managers, project team members, and/or project contacts for each organization.



Acronyms:

SPM: Site Project Manager
HSO: Health & Safety Officer
ESAT: Environmental Sevices Assistance Team

QAPP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Point of contact with EPA OSC	Site Project Manager, Weston Solutions, Inc., RST 3	Michael Garibaldi, SPM	732-585-4419	All technical, QA and decision-making matters in regard to the project (verbal, written or electronic)
Adjustments to QAPP	Site Project Manager, Weston Solutions, Inc., RST 3	Michael Garibaldi, SPM	732-585-4419	QAPP approval dialogue
Health and Safety On-Site Meeting	Site Project Manager, Weston Solutions, Inc., RST 3	Michael Garibaldi, SPM	732-585-4419	Explain/review Site hazards, personnel protective equipment and local hospital.

OSC: On-Scene Coordinator

QAPP Worksheet #7: Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Joel Petty	EPA On-Scene Coordinator	EPA, Region II	All project coordination, direction and decision making.	NA
Michael Garibaldi	SPM, RST 3	Weston Solutions, Inc.	Implementing and executing the technical, QA and health and safety during sampling event and sample management.	15+ years*
Adrianna Morocho	Field Team, RST 3	Weston Solutions, Inc.	Sample Collection	2+ years*

*All RST 3 members, including subcontractor’s resumes are in possessions of RST 3 Program Manager, EPA Project Officer and Contracting officers.

QAPP Worksheet #8: Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
[Specify location of training records and certificates for samplers]						
QAPP Training	This training is presented to all RST 3 personnel to introduce the provisions, requirements, and responsibilities detailed in the UFP QAPP. The training presents the relationship between the site-specific QA Project Plans (QAPPs), SOPs, work plans, and the Generic QAPP. QAPP refresher training will be presented to all employees following a major QAPP revision.	Weston Solutions, Inc., QAO	As needed	All RST 3 field personnel upon initial employment and as refresher training	Weston Solutions, Inc.	Weston Solutions, Inc., EHS Database
Health and Safety Training	Health and safety training will be provided to ensure compliance with Occupational Safety and Health Administration (OSHA) as established in 29 CFR 1910.120.	Weston Solutions, Inc., HSO	Yearly at a minimum	All Employees upon initial employment and as refresher training every year	Weston Solutions, Inc.	Weston Solutions, Inc., EHS Database
Others	Scribe®, ICS 100 and 200, and Air Monitoring Equipment Trainings provided to all employees	Weston Solutions, Inc., QAO/Group Leader's	Upon initial employment and as needed			
	Dangerous Goods Shipping	Weston Solutions, Inc., HSO	Every 2 years			

All team members are trained in the concepts and procedures in recognizing opportunities for continual improvement, and the approaches required to improve procedures while maintaining conformance with legal, technical, and contractual obligations.

*All RST 3 members, including subcontractor's certifications are in possessions of RST 3 HSO.

QAPP Worksheet #9: Project Scoping Session Participants Sheet

Site Name/Project Name: Magna Metals Site
Site Location: 510 Furnace Dock Road, Cortlandt, Westchester County, New York
Operable Unit: 00
Dates of Session: March 14, 2018
Scoping Session Purpose: To discuss dates and logistics for sampling event

Name	Title	Affiliation	Phone #	E-mail Address	*Project Role
Joel Petty	EPA OSC	EPA, Region II	732-321-4388	Petty.Joel@epa.gov	OSC
Bernard Nwosu	RST 3 Group Leader	Weston Solutions, Inc.	732-321-4413	Ben.Nwosu@westonsolutions.com	RST 3 Group Leader
Michael Garibaldi	Site Project Manager	Weston Solutions, Inc.	732-585-4419	Michael.Garibaldi@westonsolutions.com	Site Project Manager

Comments/Decisions: As part of the Removal Assessment at the Magna Metals Site (the Site), Weston Solutions, Inc., Removal Support Team 3 (RST 3) has been tasked by the U.S. Environmental Protection Agency (EPA) with the collection of vapor intrusion samples, including up to 16 sub-slab soil gas samples, from up to 14 residential properties and one commercial warehouse facility located in the vicinity of the Site. RST 3 will also collect up to 10 groundwater samples from the bottom of sump locations in the basement at each residence and the warehouse facility. All sub-slab soil gas samples will be collected using 6-liter summa canisters. The sub-slab soil gas samples will be submitted to an EPA Procured Laboratory for analysis of a limited list of volatile organic compound (VOC), via the EPA Method Toxic Organics (TO-15). The groundwater samples will be collected in 40 milliliter (ml) VOA vials and submitted to an EPA Contract Laboratory Program (CLP) laboratory for Target Compound List (TCL) VOCs analysis. One trip blank sample will be submitted with the sample shipment. One field duplicate sample will be collected at the rate of one per 20 samples. A temperature blank will be placed in the cooler with the groundwater samples. All sample locations will be determined by the EPA On-Scene Coordinator (OSC). The sub-slab soil gas samples will be collected over an approximately 24-hr period for each sample. All samples will be collected for definitive data quality assurance (QA) objective. The summa canisters for sub-slab soil gas will be batch cleaned by the analyzing laboratory. The sub-slab soil gas and groundwater sampling event is scheduled to be conducted at the Site from April 2 through April 6, 2018.

Action Items: RST 3 submitted the Contract Laboratory Program (CLP) Analytical Services Request Form on March 22, 2018.

QAPP Worksheet #9: Project Scoping Session Participants Sheet (Concluded)

Consensus Decisions: Analytical data for the sub-slab soil gas samples and groundwater sump samples will be used to confirm the presence or absence of VOCs.

QAPP Worksheet #10: Problem Definition

PROBLEM DEFINITION

The EPA is conducting a Removal Assessment at the Site to define the extent of the contamination at the Site. Previous site investigations revealed vapor intrusion concerns associated with the trichloroethene (TCE) contamination in on-site buildings.

EPA has scheduled a vapor intrusion sampling event with the support of RST 3, for April 2018, which will involve the collection and laboratory analyses of sub-slab soil gas and groundwater samples. The vapor intrusion samples collected from the selected residences will be analyzed for a limited list of TO-15 VOCs, including 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 3-chloropropene, 1,1,1-trichloroethane, chloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride.

SITE HISTORY/CONDITIONS

The Site is located in Cortlandt, Westchester County, New York. The entire parcel is currently owned by Baker Capital Limited Partnership which has three buildings, and is used for offices, a laboratory, and warehousing. It was previously owned by ISC Properties, Inc. Residential areas are located around the facility. A wetland area, Furnace Brook, an unnamed tributary, and an unnamed pond are located near the Site. The portion of the parcel that includes the waste handling and disposal areas, referred to as the Site, encompasses the demolished Magna Metals building and the north and westerly leach pits; a building used to warehouse paper; and a portion of the PolyMedco building, used for offices and a laboratory.

Metal plating, polishing, and lacquering operations were conducted at the Site from 1955 to 1979. During operations, iron, lead, copper, nickel, zinc chlorides, cyanides, and sulfates were discharged to a series of leaching pits. Spent TCE was allegedly discharged to the septic system. Previous investigations and actions were performed by the New York State Department of Environmental Conservation (NYSDEC) and the Westchester County Health Department starting in 1978.

The primary characteristics of the subsurface at the Site and surrounding area consist of a sandy to silty sand overburden unit, approximately 2 to 18 feet thick, overlying Hornblende bedrock. In the leach pit area, it is presumed that much of the overburden material is fill resulting from the installation of the leach pits. The inferred depth is approximately 7 to 10 feet thick. Metal and lamp parts were found buried in this area. Overburden groundwater exists in the form of a very shallow water-bearing unit (typically less than five feet thick). Overburden groundwater flow direction is to the west toward the unnamed tributary, the wetland area, and the confluence of the unnamed tributary and Furnace Brook. Bedrock groundwater flows in a similar direction and some may discharge into the overburden water units.

QAPP Worksheet #10: Problem Definition (Continued)

PROJECT DESCRIPTION

As part of the Removal Assessment of the Site, RST 3 has been tasked by EPA with the collection of vapor intrusion air samples, including up to 16 sub-slab soil gas samples, from soil gas ports to be installed at up to 14 residences and the commercial warehouse facility located in the vicinity of the Site. RST 3 will also collect up to 10 groundwater samples, including one field duplicate sample, from the bottom of sump locations at each residence and the commercial warehouse facility. All sample locations for sub-slab soil gas and groundwater samples will be determined by the EPA OSC. The sub-slab soil gas samples will be collected over a 24-hour period from inside the residences. The sub-slab soil gas samples will be submitted to an EPA procured laboratory for analysis of a limited list of VOC, via the EPA TO-15 Method. The groundwater samples will be submitted to an EPA CLP laboratory and analyzed for TCL VOCs analysis. All samples will be collected for definitive data QA objective.

In addition, RST 3 is tasked with providing support for photographic documentation and notation in the Site logbook of all site activities, entering sampling information into the EPA Scribe database, an environmental data management system, and documenting all sampling locations.

PROJECT DECISION STATEMENTS

The analytical data from this investigation will be used to assist the EPA to verify the presence or absence of VOCs in the soil gas and groundwater samples collected from the residences and the commercial warehouse facility located in the vicinity of the Site.

QAPP Worksheet # 11: Project Quality Objectives/Systematic Planning Process Statement

Overall project objectives include: RST 3 has been tasked with the collection of vapor intrusion air samples, including up to 16 sub-slab soil gas samples from soil gas ports to be installed in up to 14 residences and one warehouse facility located in the vicinity of the Site. RST 3 will also collect up to 10 groundwater samples from sump locations in the basement at each residence and the warehouse facility. All sample locations will be determined by the EPA OSC. The sub-slab soil gas samples will be collected over a 24-hour period from inside the residences. The sub-slab soil gas samples will be submitted to an EPA procured laboratory for analysis of a limited list of VOC, via the EPA TO-15 Method. The groundwater samples will be submitted to an EPA CLP laboratory for TCL VOCs analysis. All samples will be collected for definitive data QA objective.

Who will use the data? Data will be used by the EPA, Region II On-Scene Coordinator (OSC).

What will the data be used for? The analytical data from this investigation will be used to assist the EPA to verify the presence or absence of VOCs, and to determine if there are exceedances of the EPA RSLs in the soil gas and groundwater samples collected from the residences and the commercial warehouse facility located in the vicinity of the Site.

What types of data are needed?
Sampling type and matrix: Sub-Slab Soil Gas and Groundwater.
Type of Data: Definitive data.
Analytical Techniques: Off-site laboratory analysis.
Parameters: Soil Gas: TO-15 VOCs, including 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 3-chloropropene, 1,1,1-trichloroethane, chloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride.
Groundwater: TCL VOCs.
Type of sampling equipment: 6-liter SUMMA canisters, 40-ml VOA vials
Access Agreement: Obtained by EPA, Region II OSC.
Sampling locations: To be determined on-site by EPA OSC.

How much data is needed? Up to 16 sub-slab soil gas samples and up to 10 groundwater samples will need to be collected.

How "good" does the data need to be in order to support the environmental decision?
Sampling/analytical measurement performance criteria for Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) parameters will be established. Refer to Worksheet #12, criteria for performance measurement for definitive data.

Where, when, and how should the data be collected/generated? Up to 16 sub-slab soil gas samples will be collected over a 24-hour period inside the residences and the warehouse facility. Up to 10 groundwater samples will be collected in VOA vials from sump locations in the basement of the residences and commercial warehouse facility. All field work will be conducted in accordance with procedures outlined in EPA's Environmental Response Team (ERT)/Scientific,

QAPP Worksheet # 11: Project Quality Objectives/Systematic Planning Process Statement (Concluded)

Engineering, Response and Analytical Services (SERAS) contractor's Standard Operating Procedures (SOPs) Nos. 2001, 2007, 2008 and EPA's ERT SOP No. 1704. The sampling event is scheduled to be conducted at the Site from April 2 through April 6, 2018.

Who will collect and generate the data? The sub-slab soil gas samples will be collected by RST 3 and analyzed by an EPA procured laboratory. The groundwater samples will be collected by RST 3 and analyzed by a CLP laboratory. Data will be validated by Environmental Services Assistant Team (ESAT) data reviewers.

How will the data be reported? All data will be reported by the assigned laboratories (Preliminary, Electronics, and Hard Copy format). The Site Project Manager will provide a Sampling Trip Report, Status Reports, Maps/Figures, Analytical Report, and Data Validation Report to the EPA OSC.

How will the data be archived? Electronic data deliverables will be archived in the Scribe database.

QAPP Worksheet #12A: Measurement Performance Criteria Table – EPA Method TO-15 VOCs (CLP Worksheet)

(UFP-QAPP Manual Section 2.6.2)
Complete this worksheet for each matrix, analytical group, and concentration level. Identify the data quality indicators (DQI), measurement performance criteria (MPC) and QC sample and/or activity used to assess the measurement performance for both the sampling and analytical measurement systems. Use additional worksheets if necessary. If MPC for specific DQI vary within an analytical parameter, i.e., MPC are analyte-specific, then provide analyte-specific MPC on an additional worksheet.

Matrix	Soil Gas
Analytical Group	Volatile Organic Compounds
Concentration Level	Low (ppbv)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
ERT SOP #1704	EPA Method TO-15 Low Level Scan	Precision (field)	±50% D*	Field Duplicate -NR	S & A
		Accuracy (field)	No analyte > CRQL*	Field Blank – NR	S & A
		Precision (laboratory)	±25% D*	Laboratory Replicate Sample	A
		Accuracy (laboratory)	70-130 %R*	Laboratory Audit Standard	A
		Accuracy (laboratory)	No analyte > CRQL*	Laboratory Method Blank	A

NR: Not Required.
[1]Reference number from QAPP Worksheet #21.
[2]Reference number from QAPP Worksheet #23.
*Reference Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by GC/MS, 2nd Edition, January 1999; Table 3 “Summary of Internal Quality Control Procedures for VOCs by EPA method TO-15, Revision 01/21/2000.

QAPP Worksheet #12B: Measurement Performance Criteria Table – TCL VOCs

(UFP-QAPP Manual Section 2.6.2)
Complete this worksheet for each matrix, analytical group, and concentration level. Identify the data quality indicators (DQI), measurement performance criteria (MPC) and QC sample and/or activity used to assess the measurement performance for both the sampling and analytical measurement systems. Use additional worksheets if necessary. If MPC for specific DQI vary within an analytical parameter, i.e., MPC are analyte-specific, then provide analyte-specific MPC on an additional worksheet.

Matrix	Aqueous
Analytical Group	TCL VOCs
Concentration Level	Low (µg/L)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Groundwater Sampling Procedures/General Field Sampling Giuidleines	S0M02.4	Precision (field)	Project-Specific %RPD	Field Duplicate	S & A
		Accuracy (field)	No analyte > CRQL*	Trip Blank	S & A
		Precision (laboratory)	Project-Specific %RPD; List compound specific RPD	Field Duplicate; MS/MSD**	S & A
		Accuracy (laboratory)	List compound specific %R	***DMCs; MS/MSD**	A

[1]Reference number from QAPP Worksheet #21.
[2]Reference number from QAPP Worksheet #23.
*Reference USEPA Region 2 Low/Medium Volatile Data Validation SOP most recent revision http://www.epa.gov/region2/qa/documents.htm
****Optional** MS/MSD – Reference CLP SOM02.4, Exhibit D, Table 6 for Criteria. MS/MSD samples are not required for VOC analysis as per the CLP criteria.
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM02.4, Exhibit D, Table 5 for Criteria

QAPP Worksheet #13: Secondary Data Criteria and Limitations Table

Any data needed for project implementation or decision making that are obtained from non-direct measurement sources such as computer databases, background information, technologies and methods, environmental indicator data, publications, photographs, topographical maps, literature files and historical data bases will be compared to the DQOs for the project to determine the acceptability of the data. Thus, for example, analytical data from historical surveys will be evaluated to determine whether they satisfy the validation criteria for the project and to determine whether sufficient data was provided to allow an appropriate validation to be done. If not, then a decision to conduct additional sampling for the site may be necessary.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data May Be Used (if deemed usable during data assessment stage)	Limitations on Data Use
None	None	None	None	None

QAPP Worksheet #14: Summary of Project Tasks

Sampling Tasks:

RST 3 has been tasked by EPA with the collection of vapor intrusion air samples, including up to 16 sub-slab soil gas samples, from soil gas ports to be installed at up to 14 residences and the commercial warehouse facility located in the vicinity of the Site. RST 3 will also collect up to 10 groundwater samples, including one field duplicate sample, from the bottom of sump locations at each residence and the commercial warehouse facility. All sample locations for sub-slab soil gas and groundwater samples will be determined by the EPA OSC. The sub-slab soil gas samples will be collected over a 24-hour period from inside the residences. The soil gas samples will be submitted to an EPA procured laboratory for analysis of a limited list of VOC, via the EPA TO-15 Method. The groundwater samples will be submitted to an EPA CLP laboratory and analyzed for TCL VOCs analysis. All samples will be collected for definitive data QA objective.

Analysis Tasks:

Sub-slab Soil Gas – EPA Method TO-15, limited analyte list;
Groundwater – TCL VOCs.

Quality Control Tasks:

Sub-slab soil gas and groundwater samples will be collected for definitive data QA objective. Field duplicate and matrix spike /matrix spike duplicate (MS/MSD) will not be collected for sub-slab soil gas samples. MS/MSD will not be collected for groundwater samples as per CLP protocol.

Data Management Tasks:

Activities under this project will be reported in status and trip reports and other deliverables (***e.g.,*** analytical reports, final reports) described herein. Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

The following deliverables will be provided under this project:

Trip Report: A trip report will be prepared to provide a detailed accounting of what occurred during each sampling mobilization. The trip report will be prepared within two weeks of the last day of each sampling mobilization. Information will be provided on time of major events, dates, and personnel on-site (including affiliations).

Maps/Figures: Maps depicting site layout, contaminant source areas, and sample locations will be included in the trip report, as appropriate.

Analytical Report: An analytical report will be prepared for samples analyzed under this plan. Information regarding the analytical methods or procedures employed, sample results, QA/QC results, chain-of-custody documentation, laboratory correspondence, and raw data will be provided within this deliverable.

QAPP Worksheet #14: Summary of Project Tasks (Continued)

Data Review: A review of the data generated under this plan will be undertaken. The assessment of data acceptability or usability will be provided separately, or as part of the analytical report.

Documentation and Records:

All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

Field Logbook: The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. Field logbook will be bound and paginated. All entries will be dated and signed by the individuals making the entries, and should include (at a minimum) the following

1. Site name and project number
2. Name(s) of personnel on-site
3. Dates and times of all entries (military time preferred)
4. Descriptions of all site activities, site entry and exit times
5. Noteworthy events and discussions
6. Weather conditions
7. Site observations
8. Sample and sample location identification and description*
9. Subcontractor information and names of on-site personnel
10. Date and time of sample collections, along with chain of custody information
11. Record of photographs
12. Site sketches

* The description of the sample location will be noted in such a manner as to allow the reader to reproduce the location in the field at a later date.

Sample Labels: Sample labels will clearly identify the particular sample, and should include the following:
1. Site/project number.
2. Sample identification number.
3. Sample collection date and time.
4. Designation of sample (grab or composite).
5. Sample preservation.
6. Analytical parameters.
7. Name of sampler.

Sample labels will be written in indelible ink and securely affixed to the sample container. Tie-on labels can be used if properly secured.

QAPP Worksheet #14: Summary of Project Tasks (Concluded)

Custody Seals: Custody seals demonstrate that a sample container has not been tampered with or opened. The individual in possession of the sample(s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

Assessment/Audit Tasks: No performance audit of field operations is anticipated at this time. If conducted, performance and system audit will be in accordance with the project plan.

Data Review Tasks: All sub-slab soil gas and groundwater samples will be validated by EPA ESAT data validation personnel. Laboratory analytical results will be assessed by the data reviewer for compliance with required precision, accuracy, completeness, representativeness, and sensitivity.

QAPP Worksheet #15A: Reference Limits and Evaluation Table – Sub-Slab Soil Gas (CLP Worksheet)

Matrix: Sub-Slab Soil Gas
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Analytical Method TO-15 SCAN		Project Quantitation Limit		Achievable Laboratory Limits	Achievable Laboratory Limits
		ppbv	µg/m³	ppbv	µg/m³	RLs (ppbv)	RLs (µg/m³)
Trichloroethene	79-01-6	0.07	0.38	NS		TBD	
Tetrachloroethene	127-18-4	0.07	0.47				
1,1-Dichloroethene	75-35-4	0.07	0.28				
1,1-Dichloroethane	74-34-3	0.07	0.28				
cis-1,2-Dichloroethene	156-59-2	0.07	0.28				
trans-1,2-Dichloroethene	156-60-5	0.07	0.28				
1,2-Dichloroethene	107-06-2	0.07	0.28				
1,1,1-Trichloroethane	71-55-6	0.07	0.38				
Vinyl chloride	75-01-04	0.07	0.18				
3-Chloropropene	107-05-1	0.07	0.18				
Chloroethane	75-00-3	0.07	0.18				

NS - Not specified; TBD - To be determined;

QAPP Worksheet #15B: Reference Limits and Evaluation Table – Groundwater (CLP Worksheet)

Matrix: Groundwater
Analytical Group: TCL VOCs
Concentration Level: Low

Analyte	CAS Number	Project Action Limits*	Project Quantitation Limit (ug/L)	Analytical Method – SOM02.4 Trace Quantitation Limits (ug/L)	Analytical Method – SOM02.4 Low Quantitation Limits (ug/L)
Dichlorodifluoromethane	75-71-8	NA	NS	0.5	5
Chloromethane (Methyl Chloride)	74-87-3	NA	NS	0.5	5
Vinyl Chloride	75-01-4	NA	NS	0.5	5
Bromomethane	74-83-9	NA	NS	0.5	5
Chloroethane	75-00-3	NA	NS	0.5	5
Trichlorofluoromethane	75-69-4	NA	NS	0.5	5
1,1-Dichloroethene	75-35-4	NA	NS	0.5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NA	NS	0.5	5
Acetone (2-Propanone)	67-64-1	NA	NS	5	10
Carbon Disulfide	75-15-0	NA	NS	0.5	5
Methyl Acetate	79-20-9	NA	NS	0.5	5
Methylene Chloride	75-09-2	NA	NS	0.5	5
trans-1,2-Dichloroethene	156-60-5	NA	NS	0.5	5
Methyl tert-Butyl Ether	1634-04-4	NA	NS	0.5	5
1,1-Dichloroethane	75-34-3	NA	NS	0.5	5
cis-1,2-Dichloroethene	156-59-2	NA	NS	0.5	5
2-Butanone (Methyl Ethyl Ketone)	78-93-3	NA	NS	5	10
Bromochloromethane	74-97-5	NA	NS	0.5	5
Chloroform	67-66-3	NA	NS	0.5	5
1,1,1-Trichloroethane	71-55-6	NA	NS	0.5	5
Cyclohexane	110-82-7	NA	NS	0.5	5
Carbon Tetrachloride	56-23-5	NA	NS	0.5	5
Benzene	71-43-2	NA	NS	0.5	5
1,2-Dichloroethane	107-06-2	NA	NS	0.5	5
Trichloroethene	79-01-6	NA	NS	0.5	5
Methylcyclohexane	108-87-2	NA	NS	0.5	5
1,2-Dichloropropane	78-87-5	NA	NS	0.5	5
Bromodichloromethane	75-27-4	NA	NS	0.5	5
cis-1,3-Dichloropropene	10061-01-5	NA	NS	0.5	5
4-Methyl-2-Pentanone	108-10-1	NA	NS	5	10
Toluene	108-88-3	NA	NS	0.5	5
trans-1,3-Dichloropropene	10061-02-6	NA	NS	0.5	5

NA – Not Applicable
NS – Not Specified

QAPP Worksheet #15: Reference Limits and Evaluation Table – Groundwater (Concluded) (CLP Worksheet)

Matrix: Groundwater
Analytical Group: TCL VOCs – Continued
Concentration Level: Low

Analyte	CAS Number	Project Action Limits*	Project Quantitation Limit (ug/L)	Analytical Method – SOM02.4 Trace Quantitation Limits (ug/L)	Analytical Method – SOM02.4 Low Quantitation Limits (ug/L)
1,1,2-Trichloroethane	79-00-5	NA	NS	0.5	5
Tetrachloroethene	127-18-4	NA	NS	0.5	5
2-Hexanone	591-78-6	NA	NS	5	10
Dibromochloromethane	124-48-1	NA	NS	0.5	5
1,2-Dibromoethane	106-93-4	NA	NS	0.5	5
Chlorobenzene	108-90-7	NA	NS	0.5	5
Ethylbenzene	100-41-4	NA	NS	0.5	5
Xylenes (total)	1330-20-7	NA	NS	0.5	5
Styrene	100-42-5	NA	NS	0.5	5
Bromoform	75-25-2	NA	NS	0.5	5
Isopropylbenzene	98-82-8	NA	NS	0.5	5
1,1,2,2-Tetrachloroethane	79-34-5	NA	NS	0.5	5
1,3-Dichlorobenzene	541-73-1	NA	NS	0.5	5
1,4-Dichlorobenzene	106-46-7	NA	NS	0.5	5
1,2-Dichlorobenzene	95-50-1	NA	NS	0.5	5
1,2-Dibromo-3-chloropropane	96-12-8	NA	NS	0.5	5
1,2,4-Trichlorobenzene	120-82-1	NA	NS	0.5	5
1,2,3-Trichlorobenzene	87-61-6	NA	NS	0.5	5

NA – Not Applicable
NS – Not Specified

QAPP Worksheet #16: Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	RST 3 Contractor Site Project Manager	Prior to sampling date	3/28/2018	QAPP	3/30/2018
Review of QAPP	RST 3 Contractor QAO and/or Group Leader	Prior to sampling date	3/28/2018	Approved QAPP	3/30/2018
Preparation of Health and Safety Plan	RST 3 Contractor Site Project Manager	Prior to sampling date	3/27/2018	HASP	3/30/2018
Procurement of Field Equipment	RST 3 Contractor Site Project Manager and/or Equipment Officer	Prior to sampling date	3/28/2018	N/A	N/A
Laboratory Request	RST 3 Contractor Site Project Manager and/or QAO	Prior to sampling date	3/22/2018	CLP Request Form	N/A
Field Reconnaissance/Access	RST 3 Contractor Site Project Manager; or EPA, Region II OSC	4/2/2018	4/2/2018	N/A	N/A
Collection of Field Samples	RST 3 Contractor Site Project Manager	4/2/2018	4/6/2018	N/A	N/A
Laboratory Package Received	EPA Region 2 DESA and CLP	4/13/2018	4/13/2018	Preliminary Data	NA
Validation of Laboratory Results	EPA Region 2 DESA and CLP	4/27/2018	4/30/2018	Data Validation Report	4/30/2018
Data Evaluation/ Preparation of Final Report	RST 3 Contractor Site Project Manager	4/30/2018	5/11/2018	Final Report	5/11/2018

QAPP Worksheet #17: Sampling Design and Rationale

RST 3 has been tasked by EPA with the collection of vapor intrusion samples, including up to 16 soil gas samples from soil gas ports to be installed in up to 14 residences and one commercial warehouse facility located in the vicinity of the Site. RST 3 will also collect up to 10 groundwater samples from sump locations in the basement at each residence and the warehouse facility. All sample locations will be determined by the EPA OSC.

<u>Sub-Slab Soil Gas Sampling</u>

All field sampling activities will be performed in accordance with EPA's ERT/SERAS contractor's SOP number (No.) 2001, ***General Field Sampling Guidelines.*** Vapor intrusion sampling will be conducted in accordance with EPA's ERT/SERAS contractor's SOP No. 1704: ***Summa Canister Sampling.*** All vapor intrusion air samples will be collected using pre-cleaned, 6-liter stainless steel Summa canisters equipped with shut-off valves. All the Summa canisters to be utilized for the sampling event will be pre-purged, cleaned, and prepared for sampling by the laboratory in accordance with EPA Method TO-15 (Scan). Specifically, summa canisters for sub-slab soil gas samples will be batch-cleaned. A passive laboratory-calibrated flow controller will be attached to each summa canister prior to sample collection.

Properties to be sampled do not currently have sub-slab sampling ports installed in the basements, therefore, soil gas sampling ports will be installed at the selected properties in accordance with the procedures outlined in EPA's Scientific, Engineering, Response and Analytical Services (SERAS) contractor SOP No. 2082: ***Construction and Installation of Permanent Sub-Slab Soil Gas Wells***. A 24-hour period will be allowed for the concrete used in the port installation to set completely. The newly installed ports will be inspected prior to commencing sampling setup.

For sub-slab soil gas samples, the flow controller attached to the Summa canister will be connected to each subsurface sampling port via Teflon® tubing and stainless steel Swagelok® fittings. Prior to and at the end of each sampling period, the surrounding temperature of each sampling location and the pressure of each Summa canister will be measured and recorded. Temperature measurements will be obtained using a non-contact infrared temperature gun. Pressure measurements will be obtained from the attached manometer on the flow controller assembly. After each Summa canister setup is completed, the canister shut-off valve will be opened and each sample will be collected over an approximately 24-hour period. At the end of the sampling period, each canister shut-off valve will be closed.

All sample information will be transcribed into EPA's SCRIBE sample management database from which sample labels and chains of custody record will be generated. A sample label will be affixed to an identification tag and attached to each Summa canister. All the vapor intrusion samples will be submitted to the assigned laboratory for the analysis of a limited list of VOCs, including Vinyl Chloride, 1,1-Dichloroethene, Trans-1,2-Dichloroethene, 1,1-Dichloroethane, Chloroethane, 1,2-Dichloroethane, Cis-1,2-Dichloroethene, 1,1,1-Trichloroethane, Trichloroethene, Tetrachloroethene, and 3-Chloropropene, via EPA Method TO-15 (Scan).

QAPP Worksheet #17: Sampling Design and Rationale (Concluded)

Groundwater Sampling

RST 3 has been tasked by the EPA with the collection of groundwater samples from the sump locations in the basement of each residence and the commercial warehouse facility at the Site as determined by the EPA OSC. Samples will be collected directly from the sump locations. Samples for VOC analysis will be collected in 40 ml glass VOA vials with Teflon lined septum. Clean dedicated nitrile gloves will be donned between sample locations. All aqueous samples will be preserved with 1:1 hydrochloric acid (HCl) to a pH below 2. All samples will be stored on ice immediately following collection to maintain a temperature of 4 degrees celsius (^{o}C). The samples will be collected for a definitive data QA objective. One field duplicate and one trip blank will be collected during each sampling event, and no MS/MSD samples are required for VOC analysis as per the CLP protocol. All sample information will be transcribed into EPA's SCRIBE sample management database from which sample labels and chains of custody record will be generated. The groundwater samples will be submitted to an EPA CLP laboratory for TCL VOCs analysis.

This sampling design is based on information currently available and may be modified on site in light of field-screening results and other acquired information.

The following laboratory will provide the analyses indicated:

Lab Name/Location	Sample Type	Parameters
Test America Burlington 30 Community Drive, Suite 11 South Burlington, Vermont 05403 (EPA Procured Laboratory)	Sub-slab soil gas	VOCs, via EPA Method TO-15 (Scan)
Chemtech Consulting Group 284 Sheffield Street Mountainside, New Jersey 07092 (CLP Laboratory)	Groundwater	TCL VOCs

Refer to Worksheet #20 for QA/QC samples, sampling methods and SOP.

QAPP Worksheet #18: Sampling Locations and Methods/SOP Requirements Table

Matrix	Sampling Location(s)	Units	Analytical Group(s)	Concentration Level	No. of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Sub-slab Soil Gas	Up to 16	$\mu g/m^3$	VOCs, via EPA Method TO-15	Low	Up to 16*	SOP#s 1704 and 2001	Presence of VOCs in Sub-slab Soil Gas
Groundwater	Up to 9	ug/L	TCL VOCs	Low	Up to 1 (1/20 samples)	SOP# 2007	Presence of VOCs in sump locations in basements

*Note: Field duplicate samples not required for sub-slab soil gas samples.

QAPP Worksheet #19: Analytical SOP Requirements Table

Matrix	No. of Samples	Analytical Group [Lab Assignment]	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Sub-slab soil gas	Up to 16	VOCs	Low	TO-15	6 L	6 L Summa Canister	NA	30 days
Groundwater	Up to 10	TCL VOCs	Low	SOM02.4	120 m1	3 - 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH < 2; Cool to 4°C	14 days analyze
Trip Blank	1	Trace Concentration Volatile Organics [CLP]	Trace	SOM02.4, CLP Sampler's Guide	120 ml	3 - 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH < 2; Cool to 4°C	14 days analyze

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples[1]	No. of Rinsate Blanks[2]	No. of Trip. Blanks	No. of PE Samples
Sub-slab soil gas	VOCs	Low	VOCs, via EPA Method TO-15	Up to 16	NR	NR	NR	NR	NR
Groundwater	TCL VOCs	Low	SOM02.4	Up to 9	1/20 samples per matrix	NR	NA	1 per cooler	NR

NR – Not required;
[1] No MS/MSD sample is required for TCL VOC analysis;
[2] Only required if non-dedicated sampling equipment to be used.

QAPP Worksheet #21: Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP #1704	Summa Canister Sampling Rev. 0.1 July 27, 1995	EPA/OSWER/ERT	Summa Canister with Pressure Gauge, Wrench, Teflon Tubing	N	None
SOP #2001	General Field Sampling Guidelines	EPA/OSWER/ERT	General Field Sampling Guidelines	N	None
SOP#2007	Groundwater Well Sampling; Rev. 0.0 January 1995	EPA/OSWER/ERT	Site Specific	N	None
SOP #2082	Construction and Installation of Permanent Sub-Slab Soil Gas Wells	SERAS	Site Specific	N	None

See Attachment B for SOP # 1704, 2001, 2007, and 2082.
Note: The website for EPA ERT SOPs is: www.ert.org/mainContent.asp?section=Products&subsection=List

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
MultiRAE ppbRAE	Calibrate with Zero air; span gas of 100 ppm Isobutylene	Check/ replace battery/ Clean tip or bulb if necessary	Bump Test	Prior to day's activities; anytime anomaly suspected	+/- 5 units	Replace battery, or Replace Unit	Equipment Vendor and	

QAPP Worksheet #23: Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
TO-15	Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS)	Definitive Data	Selected Volatile Organic Compounds	GC/MS	Test America Burlington 30 Community Drive, Suite 11 South Burlington, Vermont 05403 (EPA Procured Laboratory)	N
SOM02.4	USEPA Contract Laboratory Program Statement of Work for Multi-Media, Multi-Concentration Organic Analysis,; October 2006	Definitive Data	Target Compound List Volatile Organics	GC/MS	Chemtech Consulting Group 284 Sheffield Street Mountainside, New Jersey 07092 (CLP RAS Laboratory)	N

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS	See TO-15	Initial calibration: upon award of the contract, whenever the laboratory takes corrective action which may change or affect the initial calibration criteria (e.g., ion source cleaning or repair, column replacement, etc.), or if the continuing calibration acceptance criteria have not been met. Continuing calibration: Following initial calibration verification, once every 12 hours, end of run. GC/MS Tuning with 4-Bromoflurobenzene (BFB): Beginning of each 12 hour period during which standards and samples are analyzed. Retention Time Evaluation: each analysis.	Initial calibration/ Continuing calibration: relative response factor (RRF) greater than or equal to minimum acceptable response factor listed in Table 5 of procedure; %RSD must be less than or equal to value listed in Table 5 of procedure. GC/MS Tuning: See ion abundance table in TO-15. Retention Time Evaluation: +/- 0.50 minute of the internal standard retention time in the associated calibration check verification	Initial calibration: inspect system for problems (e.g., clean ion source, change the column, service the purge and trap device), correct problem, re-calibrate. Continuing calibration: inspect system, recalibrate the instrument, reanalyze samples. GC/MS Tuning: inspect the system, identify problem. MS tune criteria must be met before calibration Retention time evaluation: re-calibrate and verify, re-analyze samples back to the last good calibration check verification	EPA Procured laboratory GC/MS Technician	TO-15
GC/MS	See SOM02.4	Initial calibration: upon award of the contract, whenever the laboratory takes corrective action which may change or affect the initial calibration criteria (e.g., ion source cleaning or repair, column replacement, etc.), or if the continuing calibration acceptance criteria have not been met. Continuing calibration: Once every 12 hours	Initial calibration/ Continuing calibration: relative response factor (RRF) greater than or equal to minimum acceptable response factor listed in Table 5 of procedure; %RSD must be less than or equal to value listed in Table 5 of procedure.	Initial calibration: inspect system for problems (e.g., clean ion source, change the column, service the purge and trap device), correct problem, re-calibrate. Continuing calibration: inspect system, recalibrate the instrument, and reanalyze samples.	CLP laboratory GC/MS Technician	SOM02.4

[1] Specify the appropriate letter or number form the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing/Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS	See EPA TO-15; as per instrument manufacturer's recommendations	See EPA TO-15; as per instrument manufacturer's recommendations	See EPA TO-15; as per instrument manufacturer's recommendations	Acceptable re-calibration; see EPA TO-15	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA Procured Laboratory GC/MS Technician	EPA TO-15
GC/MS	See SOM02.4; as per instrument manufacturer's recommendations	See SOM02.4; as per instrument manufacturer's recommendations	See SOM02.4; as per instrument manufacturer's recommendations	Acceptable re-calibration; see SOM02.4	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	CLP Laboratory GC/MS Technician	SOM02.4

[1] Specify the appropriate letter or number form the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #26: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): RST 3 Site Project Manager, Weston Solutions, Inc., Region II
Sample Packaging (Personnel/Organization): RST 3 Site Project Manager and sampling team members, Weston Solutions, Inc., Region II
Coordination of Shipment (Personnel/Organization): RST 3 Site Project Manager, sampling team members, Weston Solutions, Inc., Region II
Type of Shipment/Carrier: Fed Ex
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian, and EPA CLP RAS and Non-RAS Laboratories
Sample Custody and Storage (Personnel/Organization): Sample Custodian, and EPA CLP RAS and Non-RAS Laboratories
Sample Preparation (Personnel/Organization): Sample Technicians, and EPA CLP RAS and Non-RAS Laboratories
Sample Determinative Analysis (Personnel/Organization): Sample Technicians, and Sample Custodian, and EPA CLP RAS and Non-RAS Laboratories
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples to be shipped same day of collection, and arrive at laboratory within 24 hours (1 day) of sample shipment
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As per analytical methodology; see Worksheet #19
SAMPLE DISPOSAL
Personnel/Organization: Sample Technicians, Sample Custodian, and EPA CLP RAS and Non-RAS Laboratories
Number of Days from Analysis: Until analysis and QA/QC checks are completed; as per analytical methodology; see Worksheet #19.

QAPP Worksheet #27: Sample Custody Requirements

Sample Identification Procedures: Each sample collected by Region II RST 3 will be identified by the property where it was collected, the matrix of the sample collected, the location, and the sample number. Properties were labeled on a numerical basis i.e. P001, P002, etc. The matrix identifier for soil gas is SG. The last number will represent the sample number collected from each residence at each location. e.g. P005-SG001-180403-01 – Property 005 – Sub-slab Soil Gas Location 01 – April 3, 2018 - Sample 01; P005-GW001-180403-01, Groundwater/Sump Sample, collected April 3, 2018 - Sample 01, Field sample; P005-GW001-180403-02, Groundwater/Sump Sample, collected April 3, 2018 - Sample 01; Duplicate sample. Location of the sample collected will be recorded in the project database and site logbook. A duplicate sample will be identified in the same manner as other samples and will be distinguished and documented in the field logbook. Each sample will also be labeled. Depending on the type of sample, additional information such as sampling round, date, etc. will be added.
Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Each sample will be individually identified and labeled after collection, then sealed with custody seals and enclosed in a plastic cooler. The sample information will be recorded on chain-of custody (COC) forms, and the samples shipped to the appropriate laboratory via overnight delivery service or courier. Chain-of-custody records must be prepared in Scribe to accompany samples from the time of collection and throughout the shipping process. Each individual in possession of the samples must sign and date the sample COC Record. The chain-of-custody record will be considered completed upon receipt at the laboratory. A traffic report and chain-of-custody record will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. Specific information regarding custody of the samples projected to be collected on the weekend will be noted in the field logbook. The chain-of-custody record should include (at minimum) the following: 1) Sample identification number; 2) Sample information; 3) Sample location; 4) Sample date; 5) Sample Time; 6) Sample Type Matrix; 7) Sample Container Type; 8) Sample Analysis Requested; 9) Name(s) and signature(s) of sampler(s); and 10) Signature(s) of any individual(s) with custody of samples. A separate chain-of-custody form must accompany each cooler for each daily shipment. The chain-of-custody form must address all samples in that cooler, but not address samples in any other cooler. This practice maintains the chain-of-custody for all samples in case of mis-shipment.

QAPP Worksheet #27: Sample Custody Requirements (Concluded)

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): A sample custodian at the laboratory will accept custody of the shipped samples, and check them for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the laboratory manager for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. At this time, no samples will be archived at the laboratory. Disposal of the samples will occur only after analyses and QA/QC checks are completed.

QAPP Worksheet #28A: QC Samples Table – Sub-Slab Soil Gas (CLP Worksheet)

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limit exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Sub-Slab Soil Gas
Analytical Group	Volatile Organic Compounds
Concentration Level	Low (ppbv)
Sampling SOP(s)	EPA/ERT SOP No. 1704
Analytical Method/SOP Reference	EPA TO-15
Sampler's Name	RST 3
Field Sampling Organization	Weston Solutions, Inc.
Analytical Organization	EPA Procured Laboratory
No. of Sample Locations	Up to 16

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per ≤ 20 samples	No analyte > CRQL	Suspend analysis unit source recertified	CLP Non-RAS Laboratory Technician	Accuracy	No analyte > CRQL
Laboratory Replicate Sample	1 per ≤ 20 samples	± 25% D	± 25% D	CLP Non-RAS Laboratory Technician	Precision	± 25% D
Laboratory Control Sample	1 per ≤ 20 samples	± 30% R	Flag Outliers	CLP Non-RAS Laboratory Technician	Accuracy	± 30% R

QAPP Worksheet #28B: QC Samples Table – Groundwater

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limit exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Aqueous
Analytical Group	Target Compund List Trace Concentration Volatile Organics
Concentration Level	Trace (ug/L)
Sampling SOP(s)	2001, 2007
Analytical Method/SOP Reference	SOM02.4
Sampler's Name	RST3
Field Sampling Organization	Weston Solutions, Inc.
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	Up to 9

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Method Blank	1 every 12 hours	No analyte > CRQL*		Suspend analysis; reanalyze blank and affected samples	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*	
Matrix Spike (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	61-145 %R	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene	61-145 %R
		Benzene	76-127 %R				Benzene	76-127 %R
		Trichloroethene	71-120 %R				Trichloroethene	71-120 %R
		Toluene	76-125 %R				Toluene	76-125 %R
		Chlorobenzene	75-130 %R				Chlorobenzene	75-130 %R
Matrix Spike Duplicate (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	0-14 %RPD	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Precision	1,1-Dichloroethene	0-14 %RPD
		Benzene	0-11 %RPD				Benzene	0-11 %RPD
		Trichloroethene	0-14 %RPD				Trichloroethene	0-14 %RPD
		Toluene	0-13 %RPD				Toluene	0-13 %RPD
		Chlorobenzene	0-13 %RPD				Chlorobenzene	0-13 %RPD
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d_3	65-131 %R	Check calculations and instruments, reanalyze affected samples	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	Vinyl chloride-d3	65-131 %R
		Chloroethane-d_5	71-131 %R				Chloroethane-d5	71-131 %R

*with the exception of methylene chloride, 2-butanone and acetone which can be up to 2 times the CRQL, or in some situations may require these compunds be up to 4 times the CRQL.

QAPP Worksheet #28B: QC Samples Table – Groundwater (Continued)

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limit exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Aqueous
Analytical Group	Target Compund List Trace Concentration Volatile Organics [cont'd]
Concentration Level	Trace (ug/L)
Sampling SOP(s)	2001, 2007
Analytical Method/SOP Reference	SOM02.4
Sampler's Name	RST3
Field Sampling Organization	Weston Solutions, Inc.
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	Up to 9

Lab QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**		**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**	
Deuterated Monitoring Compounds [cont'd]	all samples	1,1-Dichloroethene-d_2	55-104 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet recovery limits	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene-d2	55-104 %R
		2-Butanone-d_5	49-155 %R				2-Butanone-d5	49-155 %R
		Chloroform-d	78-121 %R				Chloroform-d	78-121 %R
		1,2-Dichloroethane-d_4	78-129 %R				1,2-Dichloroethane-d4	78-129 %R
		Benzene-d_6	77-124 %R				Benzene-d6	77-124 %R
		1,2-Dichloropropane-d_6	79-124 %R				1,2-Dichloropropane-d6	79-124 %R
		Toluene-d_8	77-121 %R				Toluene-d8	77-121 %R
		trans-1,3-Dichloropropene-d_4	73-121 %R				trans-1,3-Dichloropropene-d4	73-121 %R
		2-Hexanone-d_5	28-135 %R				2-Hexanone-d5	28-135 %R
		1,4-Dioxane-d_8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d_2	73-125 %R				1,1,2,2-Tetrachloroethane-d2	73-125 %R

QAP P Worksheet #28B: QC Samples Table – Groundwater (Concluded)

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limit exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Aqueous
Analytical Group	Target Compund List Trace Concentration Volatile Organics [cont'd]
Concentration Level	Trace (ug/L)
Sampling SOP(s)	2001, 2007
Analytical Method/SOP Reference	SOM02.4
Sampler's Name	RST3
Field Sampling Organization	Weston Solutions, Inc.
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	Up to 9

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Deuterated Monitoring Compounds [cont'd]	all samples	1,2-Dichlorobenzene-d_4	80-131 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet recovery limits	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,2-Dichlorobenzene-d4	80-131 %R
Internal Standards	all samples	60-140%		Check calculations and instruments, reanalyze affected samples	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	$\pm$ 40 % of response area, $\pm$ 20 sec retention time shift	

QAPP Worksheet #29: Project Documents and Records Table

Sample Collection Documents and Records	Analysis Documents and Records	Data Assessment Documents and Records	Other
• Site and field logbooks • COC forms • Field Data Sheets • Photo-document • CLP Sample Numbers	• Sample receipt logs • Internal and external COC forms • Equipment calibration logs • Sample preparation worksheets/logs • Sample analysis worksheets/run logs • Telephone/email logs • Corrective action documentation	• Data validation reports • Field inspection checklist(s) • Review forms for electronic entry of data into database • Corrective action documentation	CLP Analytical Request Form

QAPP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Concentration Level	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Sub-Slab Soil Gas	TO-15 VOCs	Low (Scan)	EPA TO-15	1 Week Preliminary Data 2 Weeks Written Results	TestAmerica Laboratories 30 Community Drive, Suite 11 South Burlington, VT 05403 Attn: Don Dawicki 802-660-1990 (EPA Non-RAS Laboratory)	NA
Groundwater	TCL VOCs	Low	SOM01.2	1 Week Preliminary Data 2 Weeks Written Results	Chemtech Consulting Group 284 Sheffield Street Mountainside, New Jersey 07092 Attn: Divya Mehta 908-789-8900 (CLP RAS Laboratory)	NA

NA – Not Applicable

QAPP Worksheet #31: Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
CLP Worksheet							
Laboratory Technical Systems/ Performance Audits	Every year	External	Regulatory Agency	Regulatory Agency	EPA Procured and CLP RAS Laboratories	EPA Procured and CLP RAS Laboratories	EPA or other Regulatory Agency
Performance Evaluation Samples	---	External	Regulatory Agency	Regulatory Agency	EPA Procured and CLP RAS Laboratories	EPA Procured and CLP RAS Laboratories	EPA or other Regulatory Agency
On-Site Field Inspection	---	Internal	EPA	Regulatory Agency	EPA	EPA	EPA

QAPP Worksheet #32: Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Project Readiness Review	Checklist or logbook entry	RST 3 Site Project Manager, Weston Solutions, Inc.	Immediately to within 24 hours of review	Checklist or logbook entry	RST 3 Site Project Leader	Immediately to within 24 hours of review
Field Observations/ Deviations from Work Plan	Logbook	RST 3 Site Project Manager, Weston Solutions, Inc. and EPA OSC	Immediately to within 24 hours of deviation	Logbook	RST 3 Site Project Manager and EPA OSC	Immediately to within 24 hours of deviation
Laboratory Technical Systems/ Performance Audits	Written Report	RST 3-Procured Laboratories	30 days	Letter	EPA Procured and EPA CLP Laboratory	14 days
On-Site Field Inspection	Written Report	QAO/HSO Weston Solutions, Inc.	7 calendar days after completion of the audit	Letter/Internal Memorandum	Weston's regional QAO and/or EPA OSC	To be identified in the cover letter of the report

QAPP Worksheet #33: QA Management Reports Table

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
EPA CLP RAS and Non-RAS Laboraties Data (unvalidated)	As performed	6 weeks from sample collection	EPA CLP RAS and Non-RAS Laboraties	Adly Michael, RSCC, EPA Region 2 and Contractor Project Leader
EPA CLP RAS and Non-RAS Laboraties Data (validated)	As performed	Up to 60 days after receipt of unvalidated data	EPA Region 2	Contractor Project Leader
Laboratory Technical Systems/ Performance Audits	As performed	Unknown	EPA or other Regulatory Agency	EPA CLP RAS and Non-RAS Laboraties
On-Site Field Inspection	As performed	7 calendar days after completion of the inspection	RST 3 Site Safety Officer	RST 3Site Project Manager
Field Change Request	As required per field change	Three days after identification of need for field change	RST 3 Site Project Manager	EPA OSC
Final Report	As performed	2 weeks after receipt of EPA approval of data package	RST 3 Site Project Manager	EPA OSC

QAPP Worksheet #34: Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Site/field logbooks	Field notes will be prepared daily by the RST 3 Site Project Manager and will be complete, appropriate, legible and pertinent. Upon completion of field work, logbooks will be placed in the project files.	I	RST 3 Site Project Manager
Chains of custody	COC forms will be reviewed against the samples packed in the specific cooler prior to shipment. The reviewer will initial the form. An original COC will be sent with the samples to the laboratory, while copies are retained for (1) the Sampling Trip Report and (2) the project files.	I	RST 3 Site Project Manager
Sampling Trip Reports	STRs will be prepared for each week of field sampling [for which samples are sent to an EPA CLP RAS laboratory]. Information in the STR will be reviewed against the COC forms, and potential discrepancies will be discussed with field personnel to verify locations, dates, etc.	I	RST 3 Site Project Manager
Laboratory analytical data package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	I	EPA CLP RAS and Non-RAS Laboraties
Laboratory analytical data package	Data packages will be reviewed as to content and sample information upon receipt by EPA.	I	RST 3 Site Project Manager
Final Sample Report	The project data results will be compiled in a sample report for the project. Entries will be reviewed/verified against hardcopy information.	I	RST 3 Site Project Manager

QAPP Worksheet #35: Validation (Steps IIa and IIb) Process Table (CLP Laboratory)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved.	RST 3 Site Project Manager
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	RST 3 Site Project Manager
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	EPA Region 2 Data Validation Personnel with contractor support
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	EPA Region 2 Data Validation Personnel with contractor support
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	EPA Region 2 Data Validation Personnel with contractor support, Contractor Project Leader
IIb	Field duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	RST 3 Site Project Manager

QAPP Worksheet #36: Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa / IIb	Sub-Slab Soil Gas	VOCs	Low	Validating Air Samples, Volatile Organic Analysis of Ambient Air in Canister by Method TO-15 SOP HW – 31, Revision #6, September 2016	EPA Region 2 Data Validation Personnel with contractor support
IIa / IIb	Aqueous	VOCs	Low	Data Validation SOP for Organic Analysis of Trace Concentration VOCs under SOW SOM02.4	EPA Region 2 Data Validation Personnel with contractor support

QAPP Worksheet #37: Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: Data, whether generated in the field or by the laboratory, are tabulated and reviewed for Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCCS) by the SPM for field data or the data validator for laboratory data. The review of the PARCC Data Quality Indicators (DQI) will compare with the DQO detailed in the site-specific QAPP, the analytical methods used and impact of any qualitative and quantitative trends will be examined to determine if bias exists. A hard copy of field data is maintained in a designated field or site logbook. Laboratory data packages are validated, and final data reports are generated. All documents and logbooks are assigned unique and specific control numbers to allow tracking and management.

Questions about Non-CLP data, as observed during the data review process, are resolved by contacting the respective site personnel and laboratories as appropriate for resolution. All communications are documented in the data validation record with comments as to the resolution to the observed deficiencies.

Where applicable, the following documents will be followed to evaluate data for fitness in decision making: EPA QA/G-4, *Guidance on Systematic Planning using the Data Quality Objectives Process*, EPA/240/B-06/001, February 2006, and EPA QA/G-9R, *Guidance for Data Quality Assessment*, A reviewer's Guide EPA/240/B-06/002, February 2006.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
As delineated in the ***Uniform Federal Policy for Implementing Environmental Quality Systems: Evaluating, Assessing and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP (EPA-505-B-04-900A, March 2005); Part 2A: UFP-QAPP Workbook (EPA-505-B-04-900C, March 2005); Part 2B: Quality Assurance/Quality Control Compendium: Non-Time Critical QA/QC Activities (EPA-505-B-04-900B, March 2005);*** "Graded Approach" will be implemented for data collection activities that are either exploratory or where specific decisions cannot be identified, since this guidance indicates that the formal DQO process is not necessary.

The data will be evaluated to determine whether they satisfy the PQO for the project. The validation process determines if the data satisfy the QA criteria. After the data pass the data validation process, comparison results with the PQO is done.

QAPP Worksheet #37: Usability Assessment (Concluded)

The analytical data from this investigation will be used to assist the EPA in determining the presence or absence of VOCs in the sub-slab soil gas and groundwater samples collected from the residences and the commercial warehouse facility located in the vicinity of the Site.

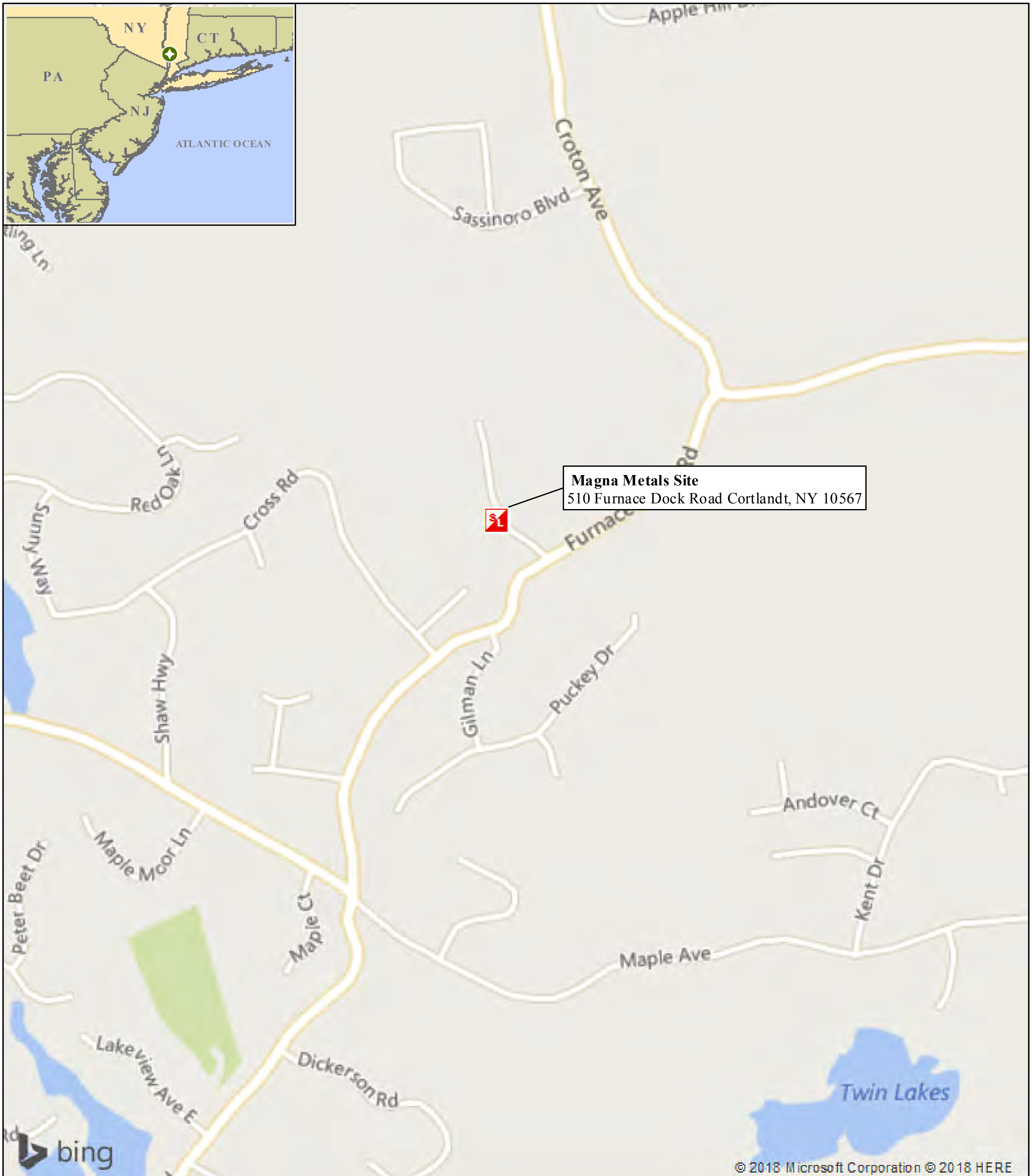
Identify the personnel responsible for performing the usability assessment: Site Project Management Team, Data Validation Personnel, and EPA, Region II OSC

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

A copy of the most current approved QAPP, including any graphs, maps and text reports developed will be provided to all personnel identified on the distribution list.

ATTACHMENT A

Figure 1: Site Location Map
Figure 2: Site Layout Map



Legend

Site Location

N

0 0.05 0.1 0.2 0.3 0.4 Miles

Weston Solutions, Inc.

In Association With Scientific and Environmental Associates, Inc., Environmental Compliance Consultants, Inc., Avatar Environmental, LLC, On-Site Environmental, Inc.and Sovereign Consulting, Inc

Figure 1:
Site Location Map

MAGNA METALS SITE
COURTLANDT, NEW YORK

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL SUPPORT TEAM 3
CONTRACT # EP-S2-14-01

GIS ANALYST:	M. BEUTHE
EPA OSC:	J. PETTY
RST SPM:	M. GARIBALDI
FILENAME:	SITE_LOCATION_MAP.MXD

SCALE

1:2,000

LEGEND

Proposed Vapor Intrusion Sample Locations

Former Magna Metals Footprint

Parcel Boundary

Figure 2:
Site Layout Map

MAGNA METALS SITE
COURTLANDT, NEW YORK

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REMOVAL SUPPORT TEAM 3
CONTRACT # EP-S2-14-01

Weston Solutions, Inc.

In Association With
Scientific and Environmental Associates, Inc., Environmental Compliance Consultants, Inc., Avatar Environmental, LLC, On-Site Environmental, Inc., and Sovereign Consulting, Inc.

GIS ANALYST:	M. BEUTHE
EPA OSC:	J. PETTY
RST 3 SPM:	M. GARIBALDI
FILENAME:	180312_SITELAYOUT_MAP.MXD
FIGURE	0
REVISION	0
DATE MODIFIED	3/23/2018

ATTACHMENT B

Sampling SOPs

EPA/ERT SOP # 1704: Summa Canister Sampling
EPA/ERT SOP # 2001: General Field Sampling Guidelines
EPA/ERT SOP # 2007: Groundwater Well Sampling
SERAS SOP # 2082: Construction and Installation of Permanent Sub-Slab Soil Gas Wells

STANDARD OPERATING PROCEDURE APPROVAL AND CHANGE FORM

Scientific, Engineering, Response and Analytical Services 2890 Woodbridge Avenue Building 209 Annex Edison New Jersey 08837-3679
STANDARD OPERATING PROCEDURE
Title: SUMMA Canister Sampling
Approval Date: 11/16/2015

Effective Date: 11/16/2015	SERAS SOP Number 1704, Rev 1.0
Authors	
Name David Adams Title SERAS Environmental Scientist Signature	Date 11/12/15
Name Title Signature	Date
Approvals	
Name Philip Solinski Title Air Response Chemist Signature	Date 11/12/15
Name Deborah Killeen Title QA/QC Officer Signature	Date 11/12/15
Name Kevin Taylor Title Program Manager Signature	Date 11/13/15

The top row of this table shows the most recent changes to the controlled document. For previous revision history information, archived versions of this document are maintained by the SERAS QA/QC Officer on the SERAS local area network (LAN).

History	Effective Date
Supersedes: SOP #1704, Revision 0.1, 07/27/95	11/16/15
Revised entire document to include both grab and time-weighted sampling	
Added additional test about the UFP-QAPP to 1.0 Scope and Application	
Expanded the data validation section to include data verification	
Removed Figure 1	

CONTENTS

SUPERSEDES: SOP #1704; Revision 0.1; 07/27/95, US EPA Contract No. 68-C4-0022

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe a procedure for sampling of Volatile Organic Compounds (VOCs) in ambient air. The method is based on samples collected as whole air samples in SUMMA or equivalent passivated stainless steel canisters. The VOCs are subsequently separated by gas chromatography (GC) and measured by mass-selective detector or multi-detector techniques. This method presents procedures for sampling into canisters at final pressures below atmospheric pressure referred to as sub-atmospheric pressure sampling.

This method is applicable to specific VOCs and a limited set of other compounds that have been tested and determined to be stable when stored in subatmospheric pressure canisters. The volatile organic compounds that have been successfully collected in canisters by this method along with their reporting limits are listed in Appendix A. These compounds results are reported as parts per billion by volume (ppbv) and micrograms per meter cubed ($\mu g/m^3$).

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure that the methods used are adequate to satisfy the data quality objectives listed in the QAPP for a particular site.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

2.0 METHOD SUMMARY

Subatmospheric pressure sampling uses an initially evacuated canister and mass flow controller to regulate flow. With this configuration, a sample of air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated SUMMA canister. Alternatively, subatmospheric pressure sampling may be performed using a fixed orifice, capillary or adjustable micro-metering valve in lieu of the mass flow controller arrangement for taking grab samples or time-integrated samples. Grab samples are typically collected during discrete odor events. For grab sampling, the canister value is opened, and the vacuum inside the canister draws in an air sample in a few seconds. Time-integrated sampling is conducted over a specific period of time to acquire a specific volume of air. The most common use is for the collection of sub-slab soil gas, indoor and ambient air samples associated with vapor intrusion activities.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Sample holding times must be determined prior to initiating field activities and are dependent on the compound (s) being analyzed. Canisters and orifices should be stored in a cool dry place and always be placed in their plastic/metal shipping boxes during transport and storage to protect the canisters from dents and/or punctures during transport.

Typically 6-liter (L) passivated canisters are used for vapor intrusion and/or odor events although 1-L canisters may also be used. After the air sample is collected, the canister valve is closed, an identification tag is attached to the canister and the canister is transported to a laboratory for analysis. Upon receipt at the laboratory, the canister tag data are recorded.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, all other sampling equipment (e.g. flow controllers) must be thoroughly cleaned. Instructions for cleaning the SUMMA canisters and flow controllers are described in the Scientific, Engineering, Response and Analytical Services (SERAS) SOP #1739, ***Procedures for SUMMA Canister and Flow Controller Cleaning***,

Care must be used with canister valves. Do not overtighten the valves.

Ambient air sampling during rainy weather may result in clogging of the flow controller filter causing reduction or stoppage of flow. Sampling during rainy weather should be avoided.

5.0 EQUIPMENT/APPARATUS

- Sampling inlet line (optional) - Teflon tubing to connect the sampler to the environment being sampled (e.g. sub-slab, ambient)

- SUMMA canister, Restek Corporation, PA, Model # 27420 or 27408 or equivalent - leak-free stainless steel pressure vessels of desired volume with valve and electropolished interior surfaces, certified clean by the laboratory for the analytes of interest and leak checked

- (Optional) Particulate matter filter, Swagelok, OH, Model SS-2F-K4-2 or equivalent - 2-µm sintered stainless steel in-line filter.

- Mass flow controller, fixed orifice, capillary or adjustable micro-metering valve, Valco Instruments, TX, VICI Model 202 or equivalent - for grab samples or time-integrated samples.

- Vacuum gauge, certified annually, to record canister vacuum in inches of mercury

- Flow meter, accompanied by an annual certificate of analysis, to verify orifice flow rates (ADM3000 or equivalent)

- Wrench, 9/16”

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURE

7.1 Grab Sample Collection

A canister, which is evacuated to one atmosphere below ambient and fitted with a flow restricting device, is opened to the atmosphere containing the VOCs to be sampled. The pressure differential causes the sample to flow into the canister. This technique may be used to collect grab samples (duration of seconds). The typical steps for collecting a grab sample are as follows:

1. With a 9/16″ wrench, remove the brass fitting from the top of the canister.

2. Attach the vacuum gauge to the canister and open the canister valve.

3. Verify and record the "Initial" reading of the evacuated SUMMA canister. The evacuated canister should read no more than -29.5 inches (") of mercury.

4. Ensure that the canister valve is fully closed before removing the vacuum gauge.

5. Place the SUMMA canister in desired location. If sampling from a vapor stream, connect inert tubing to canister sampling port.

6. Open sampling valve by turning knob counter clockwise until the knob moves easily.

7. An audible "hiss" may indicate that sampling has initiated. When the hissing stops, close valve and replace cap. Sample duration should be approximately 10 to 30 seconds.

8. Document sample collection information on the Air Sampling Worksheet (Appendix B)

7.2 Time-Weighted Average Collection

This technique may be used to collect time-integrated samples (duration of 1 to 24 hours). The sampling duration depends on the degree to which the flow is restricted.

1. With a 9/16" wrench, remove the brass fitting from the top of the canister.

2. Attach the vacuum gauge to the canister and open the canister valve.

3. Verify and record the "Initial" reading of the evacuated SUMMA canister. The evacuated canister should read no more than -29.5 "of mercury.

4. Ensure that the canister valve is fully closed before removing the vacuum gauge.

5. Check the flow rate of the orifice using a certified flow meter or a rotameter that has been checked against the primary flow meter.

6. Attach the flow controller to the top of the canister. Start the fitting by hand to avoid cross threading, then tighten firmly with a 9/16" wrench.

7. Open the valve on the canister counter clockwise and record the "start" time.

8. Monitor sampling progress periodically.

9. At the end of the sampling period, close the valve on the canister by turning clockwise until hand tight. Record the "end" time. While the ideal reading on the can gauge should be slightly negative, the actual can pressure will be tested with a calibrated gauge at the laboratory.

10. Remove the flow controller and put it into its appropriate shipping container.

11. Replace the brass fitting on top of the canister.

12. Record the final vacuum of the canister and complete the Air Sampling Worksheet - SUMMA Canister.

8.0 CALCULATIONS

A flow control device is chosen to maintain a constant flow into the canister over the desired sample period. This flow rate is determined so the canister is filled to about 5-L in a 6-L-canister for sub-atmospheric pressure sampling over the desired sample period. The flow rate can be calculated by:

$$F = \frac{(\boldsymbol{P})(V)}{(T)(60)}$$

where:

F = flow rate (***cc***/min)
P = final canister pressure, atmospheres absolute (1 for atmospheric, non-pressurized sampling)
V = volume of the canister (cm^3)
T = sample period (hours)

$$\boldsymbol{F} = \frac{\boldsymbol{(5000)}}{\boldsymbol{(24)\ (60)}} = 3.5\text{cc} / \min$$

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific QA/QC activities that apply to the implementation of these procedures will be listed in the Quality Assurance Project Plan prepared for the applicable sampling event. The following general QA procedures will also apply:

1. All SUMMA canister sampling data, including the items listed in Section 10 must be documented in site logbooks or on field data sheets.

2. All equipment must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP. Equipment check-out and calibration is necessary prior to sampling and must be done according to the instruction manuals supplied by the manufacturer. The vacuum inside each canister must be checked prior to use to ensure no leaks have occurred. The pre-set flow rates set by the laboratory are checked prior to use to ensure that the proper volume of sample will be collected.

10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: Location, Sub-location, SUMMA ID number, orifice ID number, start and end pressures, NIST vacuum gauge ID number, flow rate, flow meter ID number, start and end times. These data are essential to providing an accurate and complete final deliverable. The SERAS Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) or ERT/SERAS health and safety guidelines. More specifically, depending upon the site-specific contaminants, various protective programs must be implemented prior to some SUMMA canister sampling activities. The site health and safety plan (HASP) must be reviewed with specific emphasis placed on the protection program planned for the sampling activities. Standard operating procedures should be followed such as minimizing contact with potential contaminants in the vapor phase through the use of respirators and disposable clothing.

12.0 REFERENCES

EPA Method TO-15, ***Determination of Volatile Organic Compounds (VOCs) in Air collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry Analysis (GC/MS)***, January 1999.

13.0 APPENDICES

A - Typical Reporting Limits for Volatile Organic Compounds
B –Air Sampling Worksheet - SUMMA Canister

APPENDIX A
Typical Reporting Limits for Volatile Organic Compounds
SOP #1704
November 2015

Typical Reporting Limits for Volatile Organic Compounds

Analyte	MW	CAS Number	Reporting Limits	
			ppbv	µg/m^3
Acetone	58.08	67-64-1	0.200	0.475
Benzene	78.11	71-43-2	0.020	0.064
Bromoform (Tribromomethane)	252.73	75-25-2	0.020	0.207
Bromomethane	94.94	74-83-9	0.020	0.078
2-Butanone (MEK)	72.11	78-93-3	0.020	0.059
1,3-Butadiene	54.09	106-99-0	0.020	0.044
Carbon Tetrachloride	153.82	56-23-5	0.020	0.126
Chlorobenzene	112.56	108-90-7	0.020	0.092
Chloroethane (Ethyl Chloride)	64.51	75-00-3	0.020	0.053
Chloroform	119.38	67-66-3	0.020	0.098
Chloromethane	50.49	74-87-3	0.020	0.041
Cyclohexane	84.16	110-82-7	0.020	0.069
Dibromochloromethane	208.28	124-48-1	0.020	0.170
1,2-Dibromoethane (EDB)	187.86	106-93-4	0.020	0.154
1,2-Dichlorobenzene	147.00	95-50-1	0.020	0.120
1,3-Dichlorobenzene	147.00	541-73-1	0.020	0.120
1,4-Dichlorobenzene	147.00	106-46-7	0.020	0.120
Dichlorodifluoromethane (Freon 12)	120.91	75-71-8	0.020	0.099
1,1-Dichloroethane	98.96	75-34-3	0.020	0.081
1,2-Dichloroethane	98.96	107-06-2	0.020	0.081
1,1-Dichloroethene	96.94	75-35-4	0.020	0.079
cis-1,2-Dichloroethene	96.94	156-59-2	0.020	0.079
trans-1,2-Dichloroethene	96.94	156-60-5	0.020	0.079
Dichloromethane (Methylene chloride)	84.93	75-09-2	0.020	0.069
1,2-Dichloropropane	112.99	78-87-5	0.020	0.092
cis-1,3-Dichloropropene	110.97	10061-01-5	0.020	0.091
trans-1,3-Dichloropropene	110.97	10061-02-6	0.020	0.091
1,4-Dioxane	88.11	123-91-1	0.020	0.072
Ethyl Acetate	88.11	141-78-6	0.020	0.072
Ethylbenzene	106.17	100-41-4	0.020	0.087
4-Ethyltoluene	120.19	622-96-8	0.020	0.098

Typical Reporting Limits for Volatile Organic Compounds (cont'd)

Analyte	MW	CAS Number	Reporting Limits	
			ppbv	µg/m^3
Freon 113 (Trichlorotrifluoroethane)	187.37	76-13-1	0.020	0.153
Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane)	170.92	76-14-2	0.020	0.140
n-Heptane	100.20	142-82-5	0.020	0.082
2-Hexanone (MBK)	100.16	591-78-6	0.020	0.082
n-Hexane	86.18	110-54-3	0.020	0.070
Isopropyl Alcohol (2-Propanol)	60.10	67-63-0	0.200	0.492
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	100.16	108-10-1	0.020	0.082
Methyl Tert-Butyl Ether	88.15	1634-04-4	0.020	0.072
m & p -Xylene	106.17	108-38-3	0.040	0.174
Naphthalene	128.17	91-20-3	0.020	0.105
o-Xylene	106.17	95-47-6	0.020	0.087
Propene (Propylene)	42.08	115-07-1	0.200	0.344
Styrene	104.15	100-42-5	0.020	0.085
1,1,2,2-Tetrachloroethane	167.85	79-34-5	0.020	0.137
Tetrachloroethene	165.83	127-18-4	0.020	0.136
Tetrahydrofuran (THF)	72.11	109-99-9	0.020	0.059
Toluene	92.14	108-88-3	0.020	0.075
1,1,1-Trichloroethane	133.40	71-55-6	0.020	0.109
1,1,2-Trichloroethane	133.40	79-00-5	0.020	0.109
Trichloroethene	131.39	79-01-6	0.020	0.107
Trichlorofluoromethane (Freon 11)	137.37	75-69-4	0.020	0.112
1,2,3-Trichloropropane	147.43	96-18-4	0.020	0.121
1,2,4-Trimethylbenzene	120.19	95-63-6	0.020	0.098
1,3,5-Trimethylbenzene	120.19	108-67-8	0.020	0.098
Vinyl Acetate	86.09	108-05-4	0.020	0.070
Vinyl Chloride	62.50	75-01-4	0.020	0.051

APPENDIX B
Air Sampling Worksheet - SUMMA Canister
SOP #1704
November 2015

Page ____of____

EPA/Environmental Response Team
Scientific, Engineering, Response and Analytical Services
Lockheed Martin Corp., Edison, NJ
U.S. EPA Contract No. EP-W-09-031

Air Sampling Work Sheet - SUMMA

Site: ______________________________ WA# ________

Sampler: ___________________________ U.S. EPA/ERT WAM:________________

Date: ______________________________ SERAS Task Leader:_________________

Sample #					
Location					
Sub-Location					
Summa #					
Orifice ID					
Start Pressure					
NIST Gauge S/N					
Flow Rate (Start)					
Flow meter					
Analysis/Method					
Time/Counter (Start)					
Time/Counter (Stop)					
Total Time					
End Pressure					
NIST Gauge S/N					

MET Station on Site?: Y / N

GENERAL FIELD SAMPLING GUIDELINES

CONTENTS

Complete Rewrite: SOP #2001; Revision 1.0; 03/15/13; U.S. EPA Contract EP-W-09-031

SUPERCEDES: SOP #2001; Revision 0.0; 08/11/94; U.S. EPA Contract 68-C4-0022

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the general field sampling techniques and guidelines that will assist the Scientific Engineering Response and Analytical Services (SERAS) personnel in planning, choosing sampling strategies and sampling locations, and frequency of Quality Control (QC) samples for proper assessment of site characteristics. The ultimate goal is to ensure data quality during field collection activities.

2.0 APPLICABILITY

This SOP applies to the collection of aqueous and non-aqueous samples for subsequent laboratory analysis to determine the presence, type, and extent of contamination at a site.

3.0 DESCRIPTION

Representative sampling ensures that a sample or a group of samples accurately reflect the concentration of the contaminant at a given time and location. Depending on the contaminant of concern and matrix, several variables may affect the representativeness of the samples and subsequent measurements. Environmental variability due to non-uniform distribution of the pollutant due to topographic, meteorological and hydrogeological factors, changes in species, and dispersion of contaminants and flow rates contribute to uncertainties in sampling design.

Determining the sampling approach depends on what is known about the site from prior sampling (if any) and the site history, variation of the contaminant concentrations throughout a site, potential migration pathways, and human and environmental receptors. The objectives of an investigation determine the appropriate sampling design.

The frequency of sampling and the specific sample locations that are required must be defined in the site-specific Quality Assurance Project Plan (QAPP).

3.1 Planning Stage

The objectives of an investigation are established and documented in the site-specific QAPP. The technical approach including the media/matrix to be sampled, sampling equipment to be used, sampling design and rationale, and SOPs or descriptions of the procedure to be implemented are included in the QAPP. Refer to the matrix-specific SOPs for sampling techniques which include the equipment required for sampling.

During the planning stage, the data quality objectives (DQOs) will be determined. In turn, the project's DQOs will determine the need for screening data or definitive data. Screening data supports an intermediate or preliminary decision but eventually is supported by definitive data before the project is complete (i.e., placement of monitor wells, estimation of extent of contamination). Definitive data is suitable for final decision making, has defined precision and accuracy requirements and is legally defensible (i.e., risk assessments, site closures).

3.2. Sampling Design

Representative sampling approaches include judgmental, random, systematic grid, systematic simple random, stratified random and transect sampling. Sampling designs may be applied to soil, sediment and water; however, the random and systematic random approaches are not practical for sampling water systems, especially flowing water systems.

3.2.1 Judgmental Sampling

Judgmental sampling is the subjective selection of sampling locations based on the professional judgment of the field team. This method is useful to locate and to identify potential sources of contamination. It may not be representative of the full site and is used to document worst case scenarios. For example, groundwater sampling points are typically chosen based on professional judgment, whether permanently installed wells or temporary well points.

3.2.2 Systematic Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. A random point is chosen as the origin for the placement of the grid. A grid is constructed over a site and samples are collected from the nodes (where the grid lines intersect). Depending on the number of samples that are required to be collected, the distance between the sampling locations can be adjusted. The representativeness of the sampling may be improved by shortening the distance between sample locations.

Systematic random sampling is used for estimating contaminant concentrations within grid cells. Instead of sampling at each node, a random location is chosen within each grid cell. The systematic grid and random sampling approaches are useful for delineating the extent of contamination, documenting the attainment of clean-up goals, and evaluating and determining treatment and disposal options.

Transect sampling involves one or more transect lines established across the site. Samples are collected at systematic intervals along the transect lines. The number of samples to be collected and the length of the transect line determines the spacing between the sampling points. This type of sampling design is useful for delineating the extent of contamination at a particular site, for documenting the attainment of clean-up goals, and for evaluating and determining treatment and disposal options.

3.2.3 Simple and Stratified Random Sampling

Statistical random sampling includes simple, stratified and systematic sampling. Simple random sampling is appropriate for estimating means and total concentrations, if the site or population does not contain a major trend or pattern of contamination. A statistician will generate the sampling locations based on sound statistical methods. Stratified random sampling is a useful tool for estimating average contaminant concentrations and total amounts of contaminants within specified strata and across the entire site. It is useful when a heterogeneous population or area can be broken down into regions with less variability within the boundaries of a stratum then between the strata. Additionally, strata can be defined based on the decisions that will be made. This type of sampling design uses historical information, known ecological and human receptors, soil type, fate and transport mechanism and other ecological factors to divide the sampling area into smaller regions or strata. Sampling locations are selected from each stratum using random sampling.

The simple random sampling approach is applied when there are many sample locations and the concentrations are assumed to be homogeneous across a site with respect to the parameter(s) that are going to be analyzed or monitored for. The stratified random sampling approach is useful for sampling drums, evaluating and determining treatment and disposal options, and locating and identifying sources of contamination.

3.3 Sampling Techniques

Sampling is the selection of a representative portion of a larger population or body. The primary objective of all sampling activities is to characterize a site accurately in a way that the impact on human health and the environment can be evaluated appropriately.

3.3.1 Sample Collection Techniques

Sample collection techniques may be either grab or composite. A grab sample is a discrete aliquot representative of a specific location at a given time and collected all at once from one location. The representativeness of such samples is defined by the nature of the materials that are sampled. Samples collected for volatile organic compounds (VOCs) are always grab samples and are never homogenized. Composite samples are non-discrete samples composed of more than one specific aliquot collected at selected sampling locations. Composite samples must be homogenized by mixing prior to putting the sample into containers. Composite samples can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. Incremental sampling conducted over a grid is a special case of composite sampling and is detailed in SOP #2019, *Incremental Soil Sampling.* Choice of collecting discrete or composite samples is based on project's DQOs.

3.3.2 Homogenization

Mixing of soil and sediment samples is critical to obtain a representative sample. An adequate volume/weight of sample is collected and placed in a stainless steel or Teflon® container, and is thoroughly mixed using a spatula or spoon made of an inert material. Once the sample is thoroughly mixed the sample is placed into sample containers specific for an analysis. Avoid the use of equipment made of plastic or polyvinyl chloride (PVC) when sampling for organic compounds when the reporting limit (RL) is in the parts per billion (ppb) or parts per trillion (ppt) ranges. Refer to SERAS SOP #2012, *Soil Sampling*, for more details on homogenization.

3.3.3 Filtration

In-line filters are used specifically for collecting groundwater samples for dissolved metals analysis and for filtering large volumes of turbid groundwater. Groundwater samples collected for VOCs are typically not filtered due to potential VOC losses. Filtering groundwater is performed to remove silt particulates from samples to prevent interference with the laboratory analysis. The filters used in groundwater sampling are either cartridge type filters inserted into a reusable housing, or are self-contained and disposable. Filter chambers are usually made of polypropylene housing an inert filtering material that removes particles larger than 0.45 micrometers (µm). Refer to SERAS SOP

#2007, *Groundwater Well Sampling* and SERAS SOP #2013, *Surface Water Sampling*, for more details on filtration techniques.

3.4 Quality Assurance /Quality Control Samples

QA/QC samples provide an evaluation of both the laboratory's and the field sampling team's performance. Including QA/QC samples in a sampling design allows for identifying and measuring sources of error potentially introduced from the time of sample container preparation through analysis. The most common QA/QC samples collected in the field are collocated field duplicates, field replicates, equipment blanks, field blanks and trip blanks. Extra volume/mass is collected for a matrix spike/matrix spike duplicate (MS/MSD) at a frequency of 5% (one in 20 samples). Spiking is performed in the laboratory. For additional information or other QA/QC samples pertinent to sample analysis, refer to SERAS SOP #2005, *Quality Assurance/Quality Control Samples*.

Collocated field duplicates may be collected based on site objectives and used to measure variability associated with the sampling process including sample heterogeneity, sampling methodology, and analytical procedures. Field replicates are field samples obtained from one location, homogenized, and divided into separate containers. This is useful for determining whether the sample has been homogenized properly. Equipment blanks (also known as rinsate blanks) are typically collected at a rate of one per day. The equipment blank is used to evaluate the relative cleanliness of non-dedicated equipment.

3.5 Sample Containers, Preservation, Storage and Holding Times

The amount of sample to be collected, the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix sampled and the analyses to be conducted. This information is provided in SERAS SOP #2003, *Sample Storage, Preservation, and Handling*. Field personnel need to be cognizant of any short holding times that warrant immediate shipment/transfer to the laboratory.

3.6 Documentation

Field conditions and site activities must be documented. Scribe will be used to document sample locations and generate chain of custody records. Other field measurements not typically entered into Scribe will be documented in a site-specific logbook or in a personal logbook. All sample documentation will be maintained in accordance with SERAS SOP #2002, *Sample Documentation* and SERAS SOP #4005, *Chain of Custody Procedures.*

4.0 RESPONSIBILITIES

4.1 SERAS Task Leaders

Task Leaders (TLs) are responsible for the overall management of the project. Task Leader responsibilities include ensuring that field personnel are well informed of the sampling requirements for a specific project and that SOP and QA/QC procedures stated in the site-specific QAPP are adhered to, issuing a Field Change Form that documents any changes to sampling activities after the QAPP has been approved and maintaining sample documentation.

4.2 SERAS Field Personnel

Field personnel are responsible for reading the QAPP prior to site activities and performing sample collection activities as written. They are responsible for notifying the TL of deviations from sample collection protocols which occurred during the execution of sampling activities. Field staff will collect samples and prepare documentation in accordance with SERAS SOP #2002, *Sample Documentation*. In addition, field personnel are responsible for reading and conforming to the approved site-specific Health and Safety Plan (HASP).

4.3 SERAS Program Manager

The SERAS Program Manager is responsible for the overall technical and financial management of the project.

4.4 SERAS QA/QC Officer

The QA/QC Officer is responsible for reviewing this SOP and ensuring that the information in this SOP is updated on a timely basis. Compliance to this SOP may be monitored by either conducting a field audit or reviewing deliverables prepared by the SERAS TL.

4.5 Health and Safety (H&S) Officer

The H&S Officer is responsible for ensuring that a HASP has been written in conformance with SOP # 3012, *SERAS Health and Safety Guidelines for Field Activities* and approved prior to field activities. Additionally, the H& S Officer is responsible for ensuring that SERAS site personnel's H&S training is current as per SOP # 3006, *SERAS Field Certification Program* and that their medical monitoring is current as per ***SERAS SOP #3004, SERAS Medical Monitoring Program.***

STANDARD OPERATING PROCEDURE APPROVAL AND CHANGE FORM

Scientific, Engineering, Response and Analytical Services 2890 Woodbridge Avenue Building 209 Annex Edison New Jersey 08837-3679
STANDARD OPERATING PROCEDURE
Title: Groundwater Well Sampling
Approval Date: 06/25/2015
Effective Date: 06/25/2015	SERAS SOP Number: 2007, Rev 1.0
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The top row of this table shows the most recent changes to the controlled document. For previous revision history information, archived versions of this document are maintained by the SERAS QA/QC Officer on the SERAS local area network (LAN).

History	Effective Date
Supersedes: SOP #2007, Revision 0.0, dated 4/16/01	06/25/14

GROUNDWATER WELL SAMPLING

CONTENTS

CONTENTS (cont.)

Complete Rewrite, Supersedes: SOP#2007; Revision 0.0; 04/16/01; U.S. EPA Contract 68-C99-223

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) provides general information on how to collect groundwater samples from monitor wells and other wells for field screening or laboratory analysis. The procedures in this SOP are designed for sampling in conjunction with analysis of the most common groundwater contaminants, i.e. volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, herbicides, polychlorinated biphenyls (PCBs) and metals including cyanide. A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure the methods used are adequate to satisfy the data quality objectives listed in the site specific QAPP (SERAS SOP # 4006, *Preparation of Quality Assurance Project Plans (QAPPs)*).

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

2.0 METHOD SUMMARY

Three methods are generally accepted to collect a groundwater sample from a well for field screening or laboratory analysis: high-flow sampling, low-flow sampling and no-purge sampling. Historically, a high-flow purging method has been used for groundwater sampling. In the mid-1990s, low-flow (low stress) purging and sampling evolved using low pumping rates. No-purge sampling devices, which began to appear in the late 1990s and early 2000s, enabled collecting a sample without the pumping or purging of groundwater prior to sampling.

2.1 High-Flow Purging and Sampling

An adequate purge is normally achieved using this method by removing three well volumes of standing groundwater at relatively high flow rates prior to sampling while recording the pumping rate, discharge volume, water level and routine groundwater parameters over time. Routine groundwater parameters may include pH, specific electrical conductance, turbidity, temperature, dissolved oxygen and oxidation-reduction potential (ORP). It is assumed that stabilization of the groundwater measurements indicates the purge water is representative of ambient water from the underlying aquifer. Groundwater quality parameters are generally considered stabilized after three consecutive sets of readings do not vary by more than 10 percent (%). The time between readings (typically 5 to 10 minutes) should be chosen to ensure enough data have been collected to document the stability of parameters. If the calculated purge volume is large, measurements taken every 15 minutes may be adequate. If the field parameters do not stabilize after three well volumes have been removed, a decision to continue purging or to collect a sample should be made by the Environmental Response Team (ERT) Work Assignment Manager (WAM).

2.2 Low-Flow Purging and Sampling

This method minimizes the purge water volume removed, the water level drawdown, and the turbidity and aeration of the groundwater by using low purging and sampling rates, generally less than 1 liter per minute (lpm) or 0.26 gallon per minute (gpm). The pump intake is set within the zone of highest contaminant concentration or flux in the screened interval, if known.

Otherwise, it is placed at the midpoint of the screened interval or open borehole. The water level in the well is maintained near the static level (within 0.3-foot) during purging and sampling. Water quality parameters (pH, specific electrical conductance, temperature, turbidity, dissolved oxygen and ORP) are monitored for stability during purging to indicate when sampling may commence. It is assumed that vertical flow within the well is not occurring.

2.3 FLUTe Well Sampling

A FLUTe well consists of a downhole liner with multiple sampling ports. Once installed the sampling system is used to purge and sample the well. The sampling system consists of a manifold, valves, tubing and a nitrogen cylinder. The process involves attaching a nitrogen supply line from the manifold to a downhole airline (U-line) to the desired port. The nitrogen supply line from the manifold is now attached to the nitrogen cylinder. The nitrogen fills the U-line at a specific pressure, flushing purge water from the sample port. This port will then be purged dry then allowed to recharge for 5 to 10 minutes (dependent upon recharge) then purging again. This process will be repeated at least three times. Once the purging has been completed a waiting period of 10 to 15 minutes will be observed and the sample can then be collected through the sample/purge line. This procedure will be applied to all sampling ports until completion.

Note: Refer to the FLUTe well installation specifications for the exact nitrogen pressure (PSI) rating. Purging and sampling the well at the wrong PSI may damage the well.

2.4 No-Purge Discrete Sampling

Passive sampling techniques do not involve purging or pumping of the well before collection of a groundwater sample. A discrete sample is collected at a specific location in the well using a grab, diffusion, or adsorption device. These samplers are typically placed in the well and allowed to equilibrate during a deployment period before a sample is collected. Well water within the screened or open interval is assumed to be in equilibrium with the aquifer water and it is also assumed that there is no vertical flow of groundwater in the well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

The analytical method specifies the type of bottle, preservative, holding time and filtering requirements for a groundwater sample. Samples should be collected, when possible, directly from the sampling device into appropriate sample containers. Check that a Teflon liner is present inside the cap of the sample container, if required. Attach a sample identification label. Record all pertinent data in a site-specific logbook. A chain of custody (COC) record will be generated using Scribe.

The samples should be placed in a cooler and maintained at less than or equal ($\leq$) to 6 degrees Celsius (^{O}C) and protected from sunlight. Ideally, samples should be shipped within 24 hours of collection. If large numbers of samples are being collected, shipments may occur on a regular basis after consulting the analytical laboratory where the samples will be shipped for analysis. In all circumstances, samples need to be shipped and analyzed before the holding time expires.

Due to the trace levels at which VOCs are detectable, potential of cross-contamination and the introduction of contaminants must be avoided. Treatment of the sample with sodium thiosulfate preservative is required only if there is residual chlorine in the water that could cause free radical chlorination and change the identity of the original contaminants. This preservative should not be used if there is no chlorine in the water. Quality assurance/quality control (QA/QC) samples are incorporated into the shipment package to provide a check for cross-contamination. Samples for the analysis SVOC, pesticides, herbicides and PCBs do not normally require preservation. Samples for the analysis of VOCs typically require preservation with hydrochloric acid prior to shipment to the laboratory. Groundwater samples collected for metals and cyanide analyses are required to be adjusted with nitric acid to a pH of less than (<) 2 and sodium hydroxide to a pH of greater than (>) 12, respectively. For further details refer to Scientific, Engineering, Response and Analytical Services (SERAS) SOP# 2003, *Sample Storage, Preservation and Handling*.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 Effects Caused by Well Installation and Development

The main goal of most well sampling is to obtain a sample that represents the groundwater in a specific location in an aquifer. Improperly installed (i.e. faulty filter pack or poorly grouted seal) or inadequately developed wells may not provide representative groundwater samples. Installation and development logs for the wells to be sampled should be reviewed prior to mobilizing to the field. Newly installed wells should generally not be sampled until at least 24 hours after development.

4.2 Effects Caused by Change in Sample Environment

In-situ groundwater is usually under different conditions of aeration/oxidation, pressure, gas content and temperature than those found at the ground surface. Therefore, the chemical composition of the groundwater may change between the time of collection and the time of analysis. It may be difficult to avoid some of those changes. However, proper sample collection and preparation procedures should be used to minimize chemical changes in groundwater samples.

4.3 Presence of Immiscible Fluids

The presence of a floating or sinking organic layer in a well may require re-evaluation of the sampling design. Wells containing Light Non-Aqueous Phase Liquid (LNAPL) are generally not sampled for dissolved concentrations of VOCs and SVOCs (i.e. usually petroleum-derived products). LNAPL can usually be detected on top of the water column in a well using an interface probe, clear bailer or steel tape with color-gauge water finding paste. Wells containing dense non-aqueous phase liquid (DNAPL) are often sampled for VOCs, SVOCs, or PCBs. DNAPL can be detected at the bottom of the water column in a well using an interface probe or clear bailer.

5.0 EQUIPMENT/APPARATUS

All equipment used in groundwater purging and sampling must be constructed of materials that do not introduce contaminants or alter the contaminants being investigated. The devices used in groundwater purging and sampling of wells for a variety of contaminants are listed in Table 1, Appendix A and in Figures 1 through 10, Appendix B and discussed below.

5.1 Bailers

Bailers are best suited to sampling shallow or small diameter wells. Other devices may be more appropriate for deep, larger diameter wells that require removal of large volumes of water. Bailers are generally not recommended for the collection of groundwater samples. Bailers consist of a rigid length of tube, with a ball check-valve at the bottom (standard bailer) or top and bottom (point-source bailer). The four most common types of bailers are made of poly-vinyl chloride (PVC), polyethylene, Teflon and stainless steel. A non-reactive line is used to lower and raise the bailer in the well.

Advantages:

- No power source needed
- Portable
- Inexpensive
- Dedicated, the potential of cross-contamination is minimal
- Readily available
- Simple method for removing small volumes of purge water
- Does not subject the sample to pressure extremes

Disadvantages:

- Time-consuming to purge large volumes of groundwater from well
- The valve at the bottom of the bailer often leaks; thus, the potential exists to lose part of the sample
- Bailing may disturb the water column causing changes to the field parameters to be measured
- May result in aeration of the groundwater and stripping of VOCs and SVOCs from the sample

5.2 No Purge Samplers

No purge or passive samplers make it possible to collect groundwater samples without pumping or purging a well. These samplers are lowered to a desired depth within the screened interval or open borehole. Most of these samplers can be stacked to obtain samples at a series of depths. They can provide reproducible and accurate data, if correctly used for sampling. There are three main categories of no purge samplers currently available, they include:

1. Grab-type samplers provide an instantaneous representation of analyte concentrations within the discrete interval to which they are lowered. These are activated by pulling up, using an up and down motion, or triggering at the surface. These samplers cannot all be used to collect groundwater samples for every type of chemical analysis; therefore, the manufacturer's instructions should be consulted to determine if the target analyte can be sampled with a specific device. Sampler capacities range from 40 milliliters (mL) to over 4 liters (L) but may not provide a sufficient volume of water to enable testing for all chemicals of concern during a single deployment. Some of these samplers are designed to be left in the well for an equilibration period prior to sampling. This period allows the natural conditions to be re-established following any disturbances caused by deploying the sampler down well through the water column.

   Some common grab-type samplers include:

   - HydraSleev

- Snap Sampler
- Discrete Interval Sampler (DIS)
- Kemmerer Sampler

2. Diffusion-equilibrium samplers rely on diffusion of the analytes to attain equilibrium between the sampler and the groundwater. Equilibration times vary from several days to a few weeks depending on the type of sampler, conditions in the well, transmissivity of the aquifer or natural flushing rate of the well, and properties of the contaminant (ITRC, 2006). The minimum recommended time between deploying and retrieving these samplers is generally two weeks. Typically, the samples contain time-averaged concentrations from the last few days of the deployment period.

   Some common diffusion-equilibrium-type samplers include:
   - Regenerated-Cellulose Dialysis Membrane Sampler (RCDMS)
   - Nylon-Screen Passive Diffusion Sampler (NSPDS)
   - Polyethylene Diffusion Bag Sampler (PDB)
   - Rigid Porous Polyethylene Sampler (RPPS)

5.3 FLUTe Well Sampling System

The FLUTe sampling system consists of a manifold, valves, tubing and a nitrogen cylinder. The manifold consists of multiple valves and is a connection point for the nitrogen supply line and downhole airline or (U-line). A water level indicator will be deployed down the water line or (Tag Line) to ensure the groundwater is at the appropriate depth and to ensure the FLUTe liner is intact. Once the water level measurements have been recorded, the sampling process may begin.

Note: Refer to the FLUTe well installation specifications for the exact nitrogen pressure(PSI) setting. Purging and sampling the well at the wrong PSI may damage the well.

Advantages:
- The FLUTe system allows the installation of multiple wells or sampling intervals within one well. In theory, it's more cost effective as only one well has to be installed as opposed to the sampling of multiple wells.
- Sampling is relatively quick as there is very little volume to purge.

Disadvantages:
- Specialized equipment and supplies are required for the well sampling

5.4 Positive Displacement Pumps

Three types of positive displacement pumps typically used for purging and sampling of groundwater wells are bladder, gear-drive, and centrifugal. Positive displacement pumps designed for groundwater monitoring are constructed of non-sorptive materials (stainless steel, Viton and Teflon). Heat dissipated by submersible pump motors (i.e. gear-drive and centrifugal) may increase the sample temperature, causing loss of dissolved VOCs and precipitation of dissolved metals (Nielsen and Nielsen, 2006). Some positive displacement pumps can be easily disassembled for cleaning. However, decontamination of certain centrifugal pumps may be difficult and labor intensive as they contain a number of intricate parts.

Bladder pumps consist of the housing, bladder assembly and intake screen/filter. The housing and intake screen are constructed of stainless steel or PVC, while the replaceable bladder cartridge is made of Teflon or low-density polyethylene (LDPE). Air supply and discharge lines extend to the pump from the surface. Compressed air (typically nitrogen or ultra-zero air) is alternately applied to the supply line using a pump controller at the surface. The on/off cycles of compressed air squeeze the bladder to displace water out of the pump toward the surface then exhaust to allow the bladder to refill. Water enters the pump under hydrostatic pressure through an inlet check valve at the bottom of the pump. A check valve above the bladder prevents back flow into the pump from the discharge line. Bladder pumps can be either portable if the wells are shallow or dedicated if the wells are deep. Portable bladder pumps are limited to a depth of approximately 200 feet; whereas, dedicated bladder pumps are limited to a depth of approximately 1000 feet. Bladder pumps can be used to purge and sample groundwater wells for any type of analyte.

Gear-drive pumps use an electric motor to rotate two meshing gears (a drive gear and an idler made of Teflon). The gears trap and move the water upward from the pump inlet to the discharge line. They can be powered using 12, 24 and 36 volt direct current (VDC) batteries or 110 and 220 volt alternating current (VAC) with an inverter. Fultz Pumps, Inc. makes two models (SP-300 and SP-400) of gear-drive pumps for groundwater monitoring with a lift capability of up to approximately 200 feet. A controller allows the pump flow rate to be adjusted at the surface.

Centrifugal pumps use electric motors to spin or rotate an impeller or series of impellers, which creates centrifugal force, and develops the pressure to move water through the discharge line to the surface. These pumps are available in both variable-speed and fixed-speed configurations. A variable-frequency drive (VFD) controller at the surface enables the discharge rate to be adjusted for the pump. Common models of VFD centrifugal pumps are the Grundfos® Redi-Flo2 and Redi-Flo4. They have maximum operating depths of approximately 300 and 525 feet, respectively. Flow control for fixed-speed centrifugal pumps is accomplished using a throttling valve in the discharge line at the surface.

Submersible pumps generally use an electric power source. Centrifugal submersible pumps can run off a 12-VDC rechargeable battery, or a 110 or 220-VAC power supply. Most progressive cavity submersible pumps are powered by a 12-VDC battery. Gasoline used to power electrical generators is a potential source of contamination and should be kept well away from purging and sampling equipment. Submersible pumps are available for monitoring wells of various depths and diameters.

Advantages:

- Small diameter pumps are portable and easily transported from well to well
- Relatively low to high pumping rates are possible
- Very reliable and priming is not required
- Mainly constructed of relatively inert materials

Disadvantages:

- Power or compressed air source needed

- Submersible pump might degas the sample
- Deep wells may require pumps that are heavy and cumbersome to use
- Relatively expensive
- Sediment in water may clog intake screen or impellers
- Must be decontaminated between wells
- Because pumping pulls water from the more permeable zones, contaminant contributions from lower permeability zones may be masked in the samples
- Pumping causes mixing which may destroy in-well stratification of contaminant concentrations that could exist and be vital to the investigation

5.5 Suction Pumps

Suction pumps include peristaltic and diaphragm pumps. Peristaltic pumps can be used to purge small diameter wells (two inches or less) and should only be used to sample for inorganic contaminants. Diaphragm pumps are rarely used for the purging or sampling of monitoring wells and are omitted from further discussion. Suction pumps are limited to use in wells with a depth to groundwater of less than approximately 25 feet.

The peristaltic pump is a low volume pump that uses rollers to squeeze flexible tubing (e.g., ⅜- or ¼-inch inner diameter [ID] medical grade silastic) thereby creating suction. It is required that Teflon or Teflon-lined polyethylene tubing, e.g. ⅜- or ¼-inch outside diameter (OD) be connected to the pump when sampling for VOCs, SVOCs, and PCBs. Polyethylene tubing may be used when collecting samples for metals analyses. The tubing can be dedicated to a well for long-term monitoring or should otherwise be discarded. Peristaltic pumps require a power source that is either 12 VDC or 110 VAC.

Advantages:

- Portable, inexpensive, and readily available
- Operates from either 110 VAC or 12 VDC
- Variable flow rate, easily controlled
- Dedicated or new tubing used at each well thus minimizing the chances of cross-contamination

Disadvantages:

- Restricted to wells where water levels are within 25 feet of the ground surface
- Vacuum can cause loss of dissolved gasses and volatile organics
- Generally suitable for only small diameter shallow wells
- Maximum flow rate of some types (e.g. peristaltic pumps) limited to approximately 1.0-Lpm

5.6 Inertial Pumps

The simplest inertial pump consists of a foot valve connected to semi-rigid tubing. These pump systems are available in six sizes from 6 millimeters (mm) to 25-mm OD. Foot valves are usually made of Delrin, Teflon or stainless steel and are self-tapping directly onto the tubing. The tubing commonly used in the inertial pumps is low-density polyethylene for shallow wells and high-density polyethylene, Teflon-lined polyethylene, or Teflon for intermediate and deep wells. Tubing may either be decontaminated or discarded after use or dedicated to the well.

These pumps are most appropriate to use when wells are too deep to bail by hand, too shallow or too small in diameter to warrant the use of a submersible pump, or the water table is deeper than the limit for suction. After the pump is installed in the well, rapid upstrokes and down-strokes lift the water in the tubing. Inertial pumps can be hand operated for depths shallower than approximately 45 feet or motor driven using an actuator for depths deeper than approximately 45 feet. Optimal performance of most inertial pump systems is obtained at depths less than approximately 135 feet.

Advantages:

- Portable, inexpensive, reliable, and readily available
- Offers a rapid method for purging relatively small diameter and shallow to intermediate depth wells
- Easily operated and decontaminated

Disadvantages:

- Produces agitation that could cause turbid groundwater inside the well
- May cause VOC loss from the groundwater due to agitation
- Limited to field screening or sampling narrow-diameter temporary wells
- Restricted to depths of less than approximately 135 feet
- May be time consuming to purge wells with these pumps
- Gas-driven actuator is heavy and fuel fumes may cause sample contamination

5.7 Field Equipment Checklist

5.7.1 General

- Water level indicator/sensor
- Transducer
- Keys for well lock(s)
- Monitoring equipment with a FID or PID
- Logbook
- Calculator
- Sample labels
- Chain of Custody records and custody seals
- Sample containers
- Engineer's rule
- Sharp knife (with locking blade)
- Tool box containing: screwdrivers, pliers, hacksaw, hammer, flashlight, etc.
- Leather work gloves
- Surgical gloves
- Personal Protective Equipment (PPE)
- Five gallon bucket(s)
- Plastic sheeting
- Shipping containers
- Packing materials
- Bolt cutters
- Ziploc plastic bags
- Decontamination solutions (e.g. Liqui-Nox)

- Potable water
- Aluminum foil
- Sprayers
- Preservatives, if needed
- Distilled water
- Fire extinguisher (if using a generator as a power source)
- In-line filters, 0.45 microns (µm) (typically used for sampling of dissolved metals only)
- Flow cell
- Water quality meter (e.g. Horiba or YSI)
- Permanent markers
- Duct tape, clear tape and packaging materials
- Paper towels
- 55-gallon drum(s) for storage of purged groundwater
- First aid kit
- Laptop computer with SCRIBE software
- Portable printer
- Printer paper and labels
- Power strip
- Extension cords

5.7.2 Bailers

- Bailers of appropriate size and construction material
- Nonreactive line

5.7.3 No-Purge Samplers

- Appropriate sampler
- Sample bottles, depending on the type of sampler
- Trigger line and trigger mechanism, depending on the type of sampler

5.7.4 FLUTe Well Sampling System

- Nitrogen cylinder
- FLUTe sampling manifold
- Tubing
- 5 gallon buckets (for purge water)
- Water level indicator (Solinst Model 102)

5.7.5 Positive Displacement Pumps

- Pump(s) and controller(s), depending on the type of pump used
- Generator (120 or 240 volts) or 12-volt power source, depending on the type of pump used
- Compressed air supply, depending on the type of pump used
- Extension cord(s)

- Polyethylene, Teflon or silicone tubing
- Hose clamps
- Safety cable
- Tool box containing: pipe wrenches, wire strippers, electrical tape, heat shrink wrap or tubing, hose connectors, etc.
- Teflon tape
- Winch, pulley or hoist for large submersible pumps (2-inch diameter or greater)
- Gasoline container and gasoline
- Flow meter and gate valve
- Plumbing components (nipples, reducers, plastic pipe connectors)
- Control box

5.7.6 Inertial Pumps

- Pump assembly (foot valve and tubing)
- Gas-driven actuator, if required

5.7.7 Suction Pumps

- Small diameter Teflon or polyethylene tubing (e.g. ⅜-inch OD or ¼-inch ID)
- Roll of small diameter silicone tubing (e.g. ⅜-inch OD or ¼-inch ID)
- 110 VAC generator or 12 VDC power source

6.0 REAGENTS

Reagents are used for preservation of samples, calibration of water quality meters and for decontamination of sampling equipment. Nevertheless, samples should be cooled to $\leq 4^{O}C$ and protected from sunlight in order to minimize degradation and any potential reaction due to the light sensitivity of the sample. Refer to SERAS SOP # 2003, ***Sample Storage, Preservation, and Handling***, #2006, ***Sampling Equipment Decontamination*** and #2041, ***Calibration of Water Quality Meters*** for reagents required for each specific type of application.

7.0 PROCEDURES

7.1 Office Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed and the types and amount of equipment and supplies needed (e.g. well diameter and depth of wells to be sampled).

2. Obtain the necessary monitoring and sampling equipment appropriate to the type of contaminant(s) being investigated. Availability of preservatives, packing material, sample labels and shipping coolers.

3. Decontaminate all equipment prior to use, ensure that equipment is in working order and ready to use.

4. Identify all sampling locations and secure correct well-lock keys.

7.2 Field Preparation

1. Mobilize from the least contaminated well to the most contaminated well, if known, to minimize the risk of cross-contamination.

2. Lay plastic sheeting around the well to minimize contamination of sampling equipment from soil and materials that might be adjacent to the well.

3. Remove the lock on the well cap, note the location, note the time of day, note the date and record the information in the site logbook.

4. Remove the well cap (allow 3 to 5 seconds to prevent exposure of vapors).

5. Screen the headspace of the well with an appropriate air monitoring instrument such as a flame ionization detector (FID) or photo-ionization detector (PID) to determine the potential presence of VOCs. Record the FID or the PID readings in the site logbook.

6. Measure the distance from the water surface to the referenced measuring point and record it in the site logbook. A reference point may be the top of the outer protective casing, the top of riser pipe, the ground surface, or the top of a concrete pad. Document the reference point used in the Site logbook. If floating organics are present, the water level and depth to the floating product can be measured with an interface probe operated in accordance with SERAS SOP# 2043, *Manual Water Level Measurements*.

7. Measure the total depth of the well and record the information in the site logbook and/or on a field data sheet.

8. Calculate the volume of water in the well and the volume to be purged using the calculations in Section 8.0, *Calculations*.

9. Select the appropriate purging and sampling equipment.

7.3 Purging and/or Sampling

After field preparation is completed, the purging and sampling of a groundwater well is generally performed using high or low flow methods. Wells that cannot be purged at a low flow rate (approximately 100 mL/min) without going to dryness or contain insufficient water to enable purging should be considered for no-purge sampling. The objective is to conduct consistent and representative sampling of the groundwater wells. The same methods should be used each time the wells are purged and sampled, unless a different method would improve the data quality. Applicable sampling equipment for various contaminants of concern is presented in Table 1 of Appendix A.

7.3.1 High-Flow Purging and Sampling

A representative sample is collected after a known volume of groundwater (usually three well volumes) is pumped at a relatively high flow rate (at or below rates used for development) from the well or the water quality parameters have stabilized. Water quality parameters that can be measured during purging include temperature, electrical conductance, pH, oxidation-reduction potential and turbidity. The volume of water to be purged can be determined as described in Section 8.0 *Calculations* of this SOP. Groundwater quality parameters are generally considered stabilized after three consecutive sets of readings do not vary more than 10%.

The time between readings is based on the purge rate and cumulative volume but is typically 5 to 10 minutes or when every half volume (after the initial well volume) is purged. The well should be purged enough to remove the stagnant water but not enough to induce flow from other areas. Sampling should be performed immediately after purging. Samples for VOCs are collected first when sampling for more than one set of parameters, followed in order by samples for SVOCs, PCBs, and inorganic analyses. Positive displacement and suction lift pumps are recommended for high flow purging and sampling; whereas, the use of bailers and inertial pumps is discouraged. The total volume purged, purge method, purge rate, and the start and end times of purging, water quality parameter readings and sample collection time are recorded in the site's logbook. The static water level and depth to water at the end of purging should also be recorded in the site's logbook.

7.3.2 Low-Flow Purging and Sampling

During low flow purging, the pumping rate is adjusted (typically between 100 and 500 mL/min) to minimize or stabilize the drawdown to within 0.3 foot of the static water level. Both the drawdown and water quality parameters (pH, electrical conductivity, temperature, dissolved oxygen, oxidation-reduction potential and turbidity) are monitored during the purging according to SERAS SOP# 2041, *Operation of the Hydrolab 4a Water Quality Management System*. The water quality parameters are measured in a flow cell. Measurements are typically made every five minutes or after each flow cell volume has been purged.

A sample is collected after the parameters fall within the ranges listed below for three consecutive readings:

Water level drawdown	<0.3 foot
pH	± 0.1 unit
Electrical conductance	± 3%
Temperature	± 3%
Dissolved oxygen	± 3%
Turbidity	± 10% for values greater than 1 NTU
Oxidation-Reduction Potential	± 10 millivolts

Other ranges may apply for some of the parameters listed above depending on the State or Federal guidance that may need to be adopted for evaluating their stabilization. If the parameters have not stabilized after two hours of purging; a) continue purging until stabilization is attained and collect the sample, b) stop purging, do not collect the sample, and record attempts to reach stabilization in the site's logbook, and c) stop purging, collect the sample, and record attempts to reach stabilization in the site's logbook.

Low flow purging and sampling is best performed using positive displacement pumps and in some instances may be conducted using peristaltic pumps when only inorganic parameters are targeted.

7.3.3 No-Purge Discrete Sampling

Passive samplers provide a discrete sample from the screened portion or open interval of a groundwater well without pumping or purging. The sampler must be completely submerged and should be installed at the same depth during each monitoring event for data consistency and comparability. If historical information indicates that contamination in the well is not stratified, a single deployment depth should be selected, and sampler placement at the middle of the screen or open interval may be appropriate. Several samplers can also be deployed at different depths in the well to conduct vertical profiling. These samplers collect a limited sample volume; therefore, the manufacturer should be consulted to ensure the device will provide enough water volume to conduct the required analysis and any QA/QC that may be required in the QAPP. Diffusion and adsorption samplers may require several days or weeks of deployment before a representative sample can be collected; whereas, some grab-type samplers may not require an equilibration period prior to sampling.

7.3.4 FLUTe Well Sampling Procedures

Gather and organize all of the sampling equipment and supplies; manifold, tubing, water level indicator and 5 gallon buckets.

Attach the manifold to the down-hole air line or (U-line). Attach the nitrogen supply line from the cylinder to the block. Once everything is securely attached turn on the nitrogen supply. Attach the sample tubing to the sample port directly adjacent to the U-line. Turn the valve on the manifold to the on position allowing the nitrogen to flow down the U-line. Sample purge water will now flow up and out of the sample port tubing line. Continue to purge until the line runs dry. Allow 5 to 10 minutes to recover and repeat this procedure 2 more times. After the purging process has been completed, allow another 5 to 10 minutes for the port to recover; then sample.

This procedure will be applied to all sample ports until all have been sampled.

Note: Refer to the FLUTe well installation specifications for the exact nitrogen pressure (PSI) setting. Purging and sampling the well at the wrong PSI may damage the well.

7.3.5 General Operating Procedure for Purging and Sampling

The general procedures for devices most commonly used for purging and sampling are:

<u>No-Purge Devices</u>

Consult the manufacturer's instructions for the deployment and retrieval of the applicable no-purge device selected for monitoring.

<u>Positive Displacement Pumps and Suction Pumps</u>

The following steps describe the use of positive displacement pumps in purging and sampling a well:

1. Determine the volume of water to be purged as described in Section 8.0, *Calculations,* of this SOP if conducting high-flow purging and sampling.

2. Lay plastic sheeting around the well to prevent contamination of pumps, hoses or lines with soil or other foreign materials.

3. Assemble pump, hoses and safety cable, and lower the pump into the well. Make sure the pump is set in the screened interval.

4. Attach a flow meter to the outlet hose to measure the volume of water purged or measure it with a container of known volume. If a meter is unavailable a five-gallon bucket may be used along with a stop watch.

5. Use a ground fault circuit interrupter (GFCI) or ground the generator to avoid possible electric shock.

6. Attach the power supply for submersible pumps or compressed gas cylinder or compressor for bladder pumps, and purge the well until the specified volume of water has been removed (or until field parameters, such as temperature, pH and conductivity have stabilized). Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, reduce the pumping rate.

7. Collect the sample, starting with VOCs and dispose of the purge water as specified in SERAS SOP # 2049 *Investigation-Derived Waste Management*.

8. Cap the sample container tightly and place the pre-labeled sample container into a cooler. Use a water proof marker is for labeling or a Scribe-generated Label.

9. Replace the well cap and decontaminate the pump.

10. Log the collection time, sampling method, and analyses required for all samples in the site logbook.

11. Package samples and complete necessary paperwork.

7.4 Filtering

Samples collected for dissolved metals analysis require filtration. Groundwater is primarily filtered to exclude silt and other particulates from the samples that would interfere with the laboratory analysis. In-line filters are used specifically for the preparation of groundwater samples for dissolved metals analysis, and for filtering large volumes of turbid groundwater. An in-line filter can be used with a peristaltic pump to transfer the sample from the original sample bottle, through the filter, and into a new sample container. The filter must be replaced between sampling locations.

The filters used in groundwater sampling are self-contained and disposable. Disposable filters are preferred and often used to reduce cross-contamination of groundwater samples. Disposable filter chambers are constructed of polypropylene material, with an inert filtering material within the housing. Disposable filters have barb or national pipe thread (NPT) fittings on the inlet and outlet sides of the housing to connect to 3/8-inch or 5/8-inch tubing.

7.5 Special Considerations for VOC Sampling

The proper collection of a sample for VOC analysis requires minimal disturbance of the sample to limit volatilization. Sample retrieval equipment suitable for the collection of VOCs is:

- Positive displacement bladder pumps
- Some submersible pumps
- No-purge samplers

Field conditions and other constraints will limit the choice of certain systems. The concern must be to collect a valid sample that has been subjected to the least amount of turbulence possible.

The following procedures are required to be used:

1. Open the vial, set cap in a clean place, and collect the sample. When collecting duplicate samples; collect both samples at the same time.

2. Fill the vial to almost overflowing. Do not rinse the vial, or let it excessively overflow. It needs to have a convex meniscus on the top of the vial before securing the cap.

3. Check that the cap has not been contaminated and place the cap directly over the top and screw down firmly. Do not over tighten the cap.

4. Invert the vial and tap gently. Observe vial for at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample then re-seal. Do not collect a sample with air trapped in the vial.

5. The holding time for unpreserved samples to be analyzed for VOCs is 7 or 14 days for preserved samples. Samples should be shipped or delivered to the laboratory as fast as practical in order to allow the laboratory time to analyze the samples within the holding time. Ensure that the samples are stored at $\leq 4^{O}$C during transport but do not allow them to freeze. The most readily available method of cooling is to use ice packed in double-sealed plastic bags (e.g. Ziploc bags).

8.0 CALCULATIONS

To calculate the volume of a well, use the following equation:

$$\text{Well Volume (gallons)} = \pi r^2 hk$$

where:

π = 3.14
r = radius of monitor well (feet)

h = height of the water column (feet). (This may be determined by subtracting the:
depth to water from the total depth of the well as measured from the same reference point).
k = conversion factor, 7.48 gallons per cubic foot (gal/ft^3)

The inner diameter of most monitoring wells is typically 2 to 4 inches. If the inner diameter of the monitoring well is known, standard conversion factors can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitoring well diameters can be calculated as follows:

$$\text{Volume (gal/ft.)} = \pi r^2 k$$

OR

$$\text{Volume} = 23.5r^2$$

where:

π = 3.14
r = radius of well (feet)
k = conversion factor (7.48 gal/ft^3)

For a 2-inch diameter well, the volume, in gallons per linear foot, can be calculated as follows:

$$\begin{aligned}\text{Volume/linear ft.} &= \pi r^2 k \\ &= 3.14 \times (1/12)^2 \times (7.48\ \text{gal/ft}^3) \\ &= 0.163\ \text{gal/ft}\end{aligned}$$

The well radius must be in feet to be able to use the equation.

The conversion factors (***f***) for the most common diameter monitor wells are as follows:

Well diameter-inches	2	3	4	6
Volume (gal/ft.)	0.1631	0.3670	0.6528	1.4680

If you use the conversation factors than the equation is modified as follows:

$$\text{Well Volume} = hf$$

where:

h = height of water column (feet)
f = conversion factor

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific QA/QC activities that apply to the implementation of these procedures will be listed in the Quality Assurance Project Plan prepared for the applicable sampling event. The following general QA procedures will also apply:

1. All sample collection data, including purge methods and time, sample collection methods, times of collection, analyses required, and decontamination procedures (if any) must be documented on site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer or instrument-specific SOPs, unless otherwise specified in the QAPP. Equipment check-out and calibration is necessary prior to purging and sampling and must be done according to the instruction manuals supplied by the manufacturer.

3. The collection of rinsate (equipment, field) blanks is recommended to evaluate the potential for cross-contamination from non-dedicated purging and/or sampling equipment. The determination of how many field (rinsate, equipment) blanks to be collected is dependent on the project's data quality objectives.

4. Trip blanks are required if analytical parameters include VOCs.

10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: location information, water quality parameter measurements, purging start and end times, water levels, depth to groundwater measurements, purge method and total volume pumped. These data are essential to providing an accurate and complete final deliverable. The SERAS Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) and SERAS health and safety guidelines. More specifically, depending upon the site specific contaminants, various protective programs must be implemented prior to sampling the first well. The site's health and safety plan (HASP) should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and other PPE.

When working around VOCs:

1. Avoid breathing volatile constituents venting from the well.

2. Check the well head-space with a FID/PID prior to sampling.

3. If monitoring results indicate organic concentration above the action level, it may be necessary to conduct sampling activities in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

Physical hazards associated with well sampling:

1. Lifting injuries associated with pump and bailers retrieval; moving equipment.

2. Use of pocket knives for cutting discharge hose.

3. Heat/cold stress as a result of exposure to extreme temperatures in protective clothing.

4. Slip, trip, fall conditions as a result of pump discharge.

5. Restricted mobility due to the wearing of protective clothing.

6. Electrical shock associated with use of submersible pumps is possible. Use a GFCI or a copper grounding stake to avoid this problem.

12.0 REFERENCES

Interstate Technology Regulatory Council (ITRC), 2006, Technology *Overview of Passive Sampler Technologies*, Prepared by the ITRC Diffusion Sampler Team, 94 pp.

Nielsen, D.M., and Nielsen, G.L., 2006, Ground-Water Sampling, In: Nielsen, D.M. (ed.), *Practical Handbook of Environmental Site Characterization and Ground-Water Monitoring*, 2nd Edition, Taylor and Francis, Boca Raton, Florida, pp. 959-1112.

U. S. Environmental Protection Agency, Region 9 Laboratory, Richmond, CA, 09/2004, Field Sampling Guidelines, Document #1220, "*Groundwater Well Sampling*"

ASTM Method D4468-01 "*Standard Guide for Sampling Ground-Water Monitoring Wells*", ASTM 2013

13.0 APPENDICES

A – Table
B - Figures

APPENDIX A
Tables
SERAS SOP #2007
April 2015

TABLE 1. Acceptable Purging and Sampling Equipment for Contaminants of Concern

Equipment	VOCs	SVOCs	PCBs	Pesticides/Herbicides	Metals Plus Cyanide
Bailer	X	X	X	X	X
Peristaltic/Centrifugal Pump	X	X	3	3	3
Submersible Pump	3	1	1	1	1
Bladder Pump	1	1	1	1	1
Inertial Pump	X	X	X	X	X
Diffusion Sampler	1	3	X	X	X
Adsorption Sampler	2	2	2	2	X
Grab Sampler	2	2	2	2	2

X – Not recommended for definitive data
1 – Recommended method
2 – Useful with limitations
3 – Better methods exists

APPENDIX B
Figures
SERAS SOP #2007
June 2015

FIGURE 1. Bailer

FIGURE 2. Grab-type Sampler

FIGURE 3. Diffusion-Equilibrium Sampler

FIGURE 4. Bladder Pump

FIGURE 5. Gear-Driven Pump

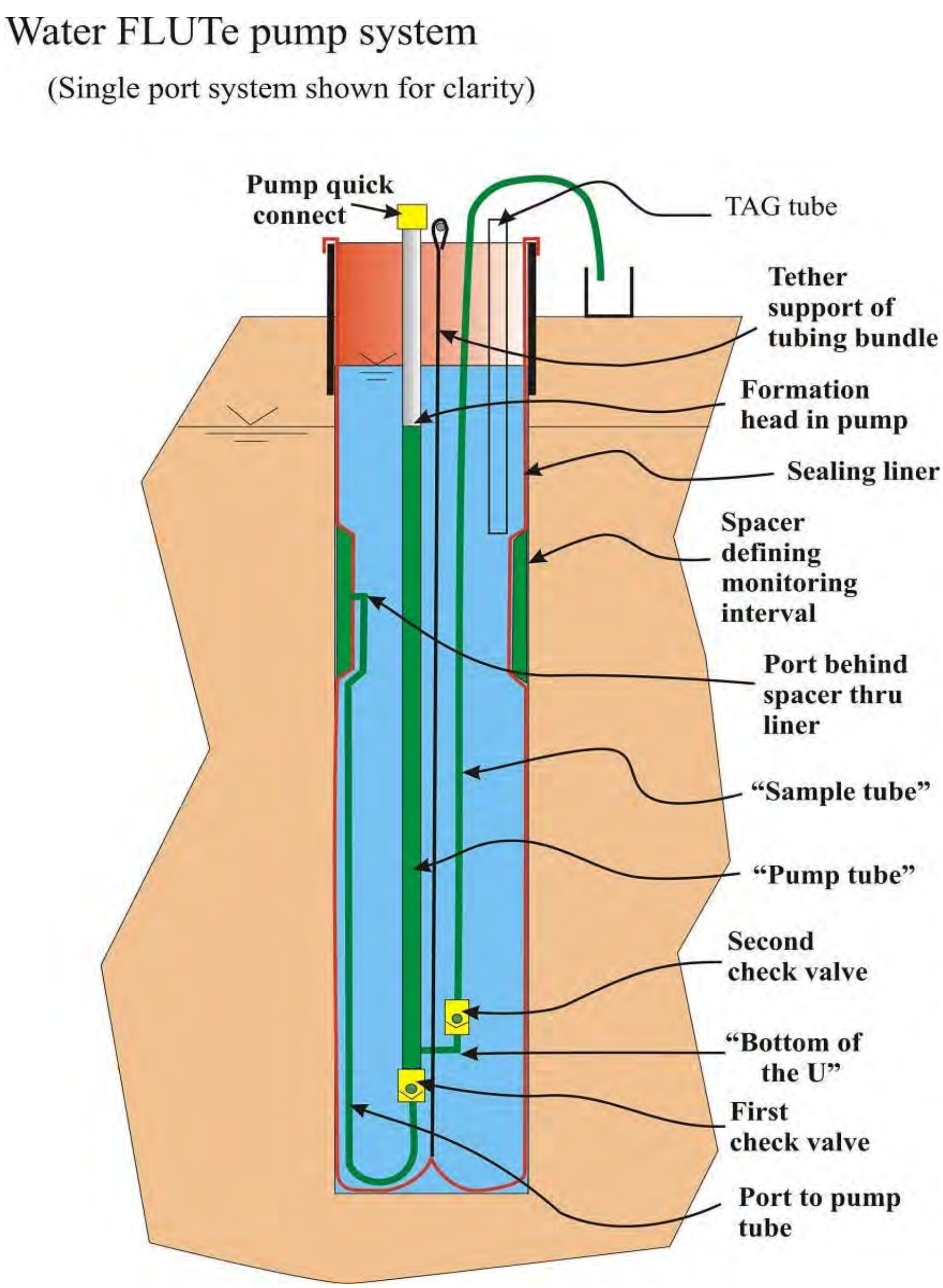
FIGURE 6. Centrifugal Pump

FIGURE 7. Peristaltic Pump

FIGURE 8. Diaphragm Pump

FIGURE 9. Foot-Valve Pump

FIGURE 10. FLUTe Well System



STANDARD OPERATING PROCEDURES

CONSTRUCTION AND INSTALLATION OF PERMANENT SUB-SLAB SOIL GAS WELLS

CONTENTS

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) outlines the procedure used for the construction and installation of permanent sub-slab soil gas wells. The wells are used to sample the gas contained in the interstitial spaces beneath the concrete floor slab of dwellings and other structures.

Soil gas monitoring provides a quick means of detecting volatile organic compounds (VOCs) in the soil subsurface. Using this method, underground VOC contamination can be identified and the source, extent and movement of pollutants can be traced.

2.0 METHOD SUMMARY

Using an electric Hammer Drill or Rotary Hammer, an inner or pilot hole is drilled into the concrete slab to a depth of approximately 2" with the d" diameter drill bit. Using the pilot hole as the center, an outer hole is drilled to an approximate depth of 1d" using the 1" diameter drill bit. The 1" diameter drill bit is then replaced with the d" drill bit. The pilot hole is drilled through the slab and several inches into the sub-slab material. Once drilling is completed, a stainless steel probe is assembled and inserted into the pre-drilled hole. The probe is mounted flush with the surrounding slab so it will not interfere with pedestrian or vehicular traffic and cemented into place. A length of Teflon tubing is attached to the probe assembly and to a sample container or system.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

3.1 SUMMA Canister Sampling

After the sub-slab soil gas sample is collected, the canister valve is closed, an identification tag is attached to the canister and the canister is transported to a laboratory under chain of custody for analysis. Upon receipt at the laboratory, the data documented on the canister tag is recorded. Sample holding times are compound dependent, but most VOCs can be recovered from the canister under normal conditions near the original concentration for up to 30 days. Refer to SERAS SOP #1704, ***SUMMA Canister Sampling*** for more details.

3.2 Tedlar Bag Sampling

Tedlar bags most commonly used for sampling have a 1-liter volume capacity. After sampling, the Tedlar bags are stored in either a clean cooler or an opaque plastic bag at ambient temperature to prevent photodegradation. It is essential that sample analysis be undertaken within 24 to 48 hours following sample collection since VOCs may escape or become altered. Refer to SERAS SOP #2102, ***Tedlar Bag Sampling*** for more details.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The thickness of a concrete slab may vary from structure to structure. A structure may also have a single slab where the thickness varies. A slab may contain steel reinforcement (REBAR). Drill bits of various sizes and cutting ability will be required to penetrate slabs of varying thicknesses or those that are steel-reinforced.

5.0 EQUIPMENT/APPARATUS

- Hammer Drill or Rotary Hammer
- Alternating current (AC) extension cord
- AC generator, if AC power is not available on site
- Hammer or Rotary Hammer drill bit, d" diameter
- Hammer or Rotary Hammer drill bit, 1"diameter
- Portable vacuum cleaner
- 1 - ¾" open end wrench or 1-medium adjustable wrench
- 2 - 9/16" open end wrenches or 2-small adjustable wrenches
- Hex head wrench, ¼"
- Tubing cutter
- Disposable cups, 5 ounce (oz)
- Disposable mixing device (i.e., popsicle stick, tongue depressor, etc.)
- Swagelok SS-400-7-4 Female Connector, ¼" National Pipe Thread (NPT) to ¼" Swagelok connector
- Swagelok SS-400-1-4 Male Connector, ¼"NPT to ¼" Swagelok connector
- ¼" NPT flush mount hex socket plug, Teflon-coated
- ¼" outer diameter (OD) stainless steel tubing, pre-cleaned, instrument grade
- ¼" OD Teflon tubing
- Teflon thread tape
- 1/8 " OD stainless steel rod, 12" to 24" length
- Swagelok Tee, optional (SS-400-3-4TMT or SS-400-3-4TTM)

6.0 REAGENTS

- Tap water, for mixing anchoring cement
- Anchoring cement
- Modeling clay

7.0 PROCEDURES

7.1 Probe Assembly and Installation

1. Drill a d" diameter inner or pilot hole to a depth of 2" (Figure 1, Appendix A).

2. Using the d" pilot hole as your center, drill a 1" diameter outer hole to a depth of 1d". Vacuum out any cuttings from the hole (Figure 2, Appendix A).

3. Continue drilling the d inner or pilot hole through the slab and a few inches into the sub-slab material (Figure 3, Appendix A). Vacuum out any cuttings from the outer hole.

4. Determine the length of stainless steel tubing required to reach from the bottom of the outer hole, through the slab and into the open cavity below the slab. To avoid obstruction of the probe tube, ensure that it does not contact the sub-slab material. Using a tube cutter, cut the tubing to the desired length.

5. Attach the measured length (typically 12O) of ¼" OD stainless tubing to the female connector

(SS-400-7-4) with the Swagelok nut. Tighten the nut.

6. Insert the ¼" hex socket plug into the female connector. Tighten the plug. **Do not over tighten**. If excessive force is required to remove the plug during the sample set up phase, the probe may break loose from the anchoring cement.

7. Place a small amount of modeling clay around the stainless steel tubing adjacent to the Swagelok nut, which connects the stainless steel tubing to the female connector. Use a sufficient amount of modeling clay so that the completed probe, when placed in the outer hole, will create a seal between the outer hole and the inner hole. The clay seal will prevent any anchoring cement from flowing into the inner hole during the final step of probe installation.

8. Place the completed probe into the outer hole. The probe tubing should not contact the sub-slab material and the top of the female connector should be flush with the surface of the slab and centered in the outer hole (Figure 4, Appendix A). If the top of the completed probe is not flush with the surface of the slab, due to the outer hole depth being greater than 1d", additional modeling clay may be placed around the stainless steel tubing adjacent to the Swagelok nut, which connects the stainless steel tubing to the female connector. Use a sufficient amount of clay to raise the probe until it is flush with the surface of the slab while ensuring that a portion of the clay will still contact and seal the inner hole.

9. Mix a small amount of the anchoring cement. Fill the space between the probe and the outside of the outer hole. Allow the cement to cure according to manufacturers instructions before sampling.

7.2 Sampling Set-Up

1. Wrap one layer of Teflon thread tape onto the NPT end of the male connector (SS-400-1-4). Refer to Figure 5, Appendix A.

2. Remove the ¼" hex socket plug from the female connector (SS-400-7-4). Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

3. To ensure that the well has not been blocked by the collapse of the inner hole below the end of the stainless steel tubing, a stainless steel rod, 1/8” diameter, may be passed through the female connector and the stainless steel tubing. The rod should pass freely to a depth greater than the length of the stainless steel tubing, indicating an open space or loosely packed soil below the end of the stainless steel tubing. Either condition should allow a soil gas sample to be collected.

   If the well appears blocked, the stainless steel rod may be used as a ramrod in an attempt to open the well. If the well cannot be opened, the probe should be reinstalled or a new probe installed in an alternate location.

4. Screw and tighten the male connector (SS-400-1-4) into the female connector (SS-400-7-4). **Do not over tighten**. This may cause the probe to break loose from the anchoring cement during this step or when the male connector is removed upon completion of the sampling

event. Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

5. If a collocated sub-slab sample or split sample is desired, a stainless steel Swagelok Tee (SS-400-3-4TMT or SS-400-3-4TTM) may be used in place of the Swagelok male connector (SS-400-1-4).

6. Attach a length of ¼"OD Teflon tubing to the male connector with a Swagelok nut. The Teflon tubing is then connected to the sampling container or system to be used for sample collection.

7. After sample collection remove the male connector from the probe and reinstall the hex socket plug. **Do not over tighten** the hex socket plug. If excessive force is required to remove the plug during the next sampling event the probe may break loose from the anchoring cement. Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

7.3 Repairing a Loose Probe

1. If the probe breaks loose from the anchoring cement while removing or installing the hex head plug or the male connector (SS-400-1-4), lift the probe slightly above the surface of the concrete slab.

2. Hold the female connector (SS-400-7-4) with the ¾" open end wrench.

3. Complete the step being taken during which the probe broke loose, following the instructions contained in this SOP (i.e., **Do not over tighten** the hex socket plug or male connector).

4. Push the probe back down into place and reapply the anchoring cement.

5. Modeling clay may be used as a temporary patch to effect a seal around the probe until the anchoring cement can be reapplied.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

An additional collocated soil gas well is installed with the frequency of 10 percent (%) or as specified in the site-specific Quality Assurance Project Plan (QAPP). The following general Quality Assurance (QA) procedures apply:

1. A rough sketch of the area is drawn where the ports are installed with the major areas noted on the sketch. This information may be transferred to graphing software for incorporation into the final deliverable.

2. A global positioning system (GPS) unit may be used to document coordinates outside of a structure as

a reference point.

3. Equipment used for the installation of sampling ports should be cleaned by heating, inspected and tested prior to deployment.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and Lockheed Martin corporate health and safety procedures. All site activities should be documented in the site-specific health and safety plan (HASP).

12.0 REFERENCES

This section is not applicable to this SOP.

13.0 APPENDICES

A - Figures

APPENDIX A
Soil Gas Installation Figures
SOP #2082
March 2007

FIGURE 1

INNER or PILOT HOLE

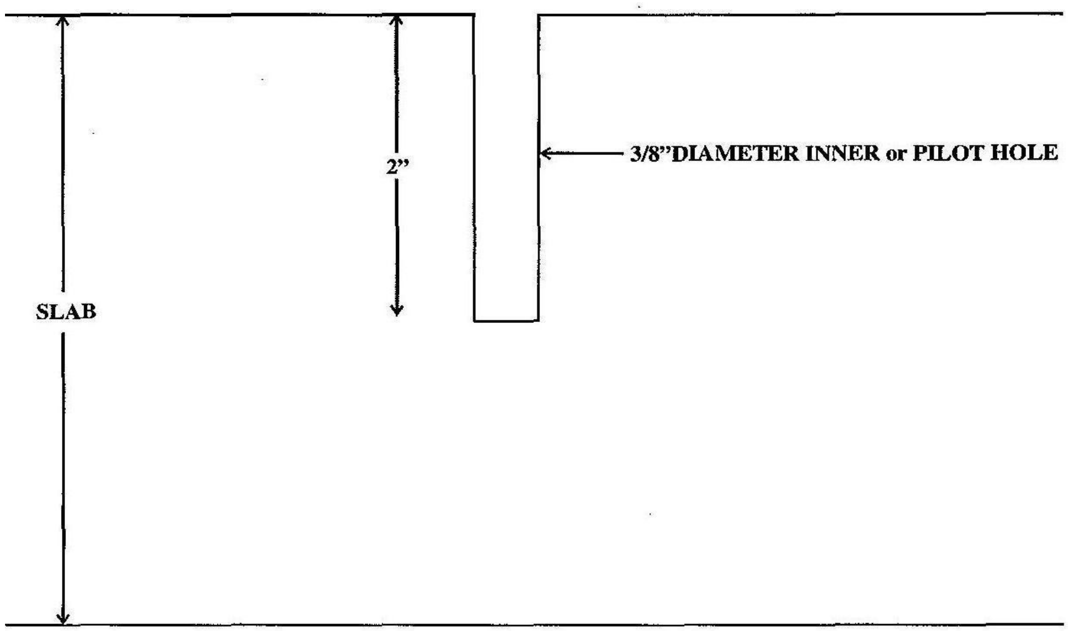


FIGURE 2

OUTER HOLE

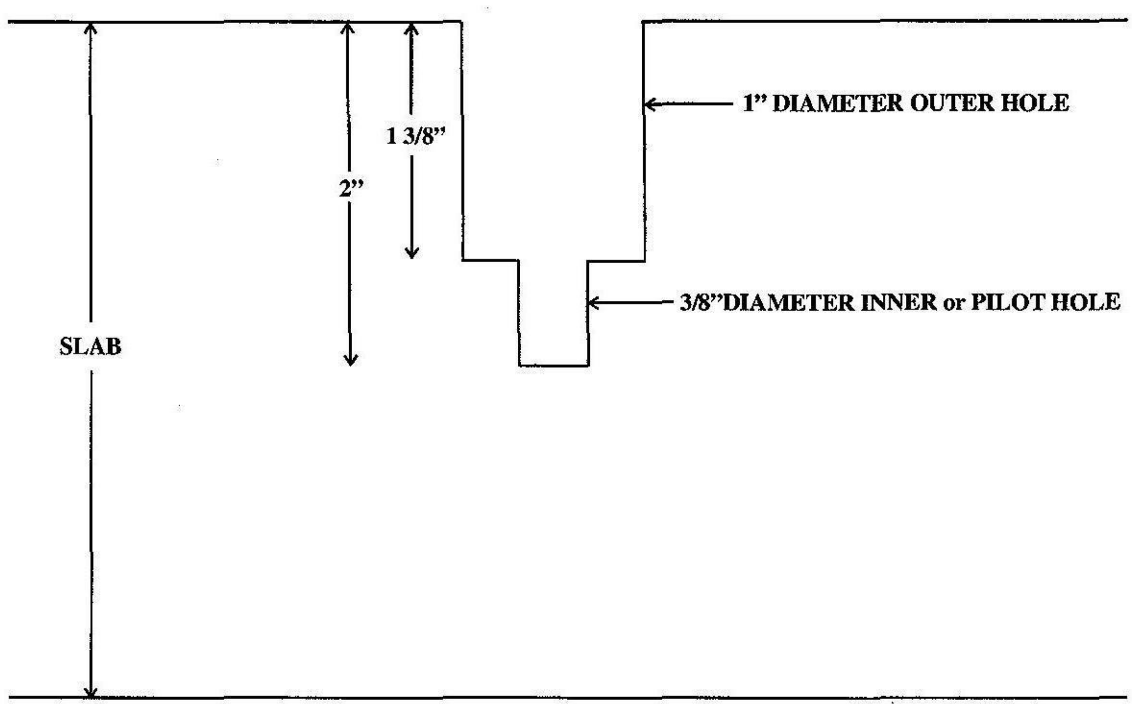


FIGURE 3

COMPLETED HOLE PRIOR to PROBE INSTALLATION

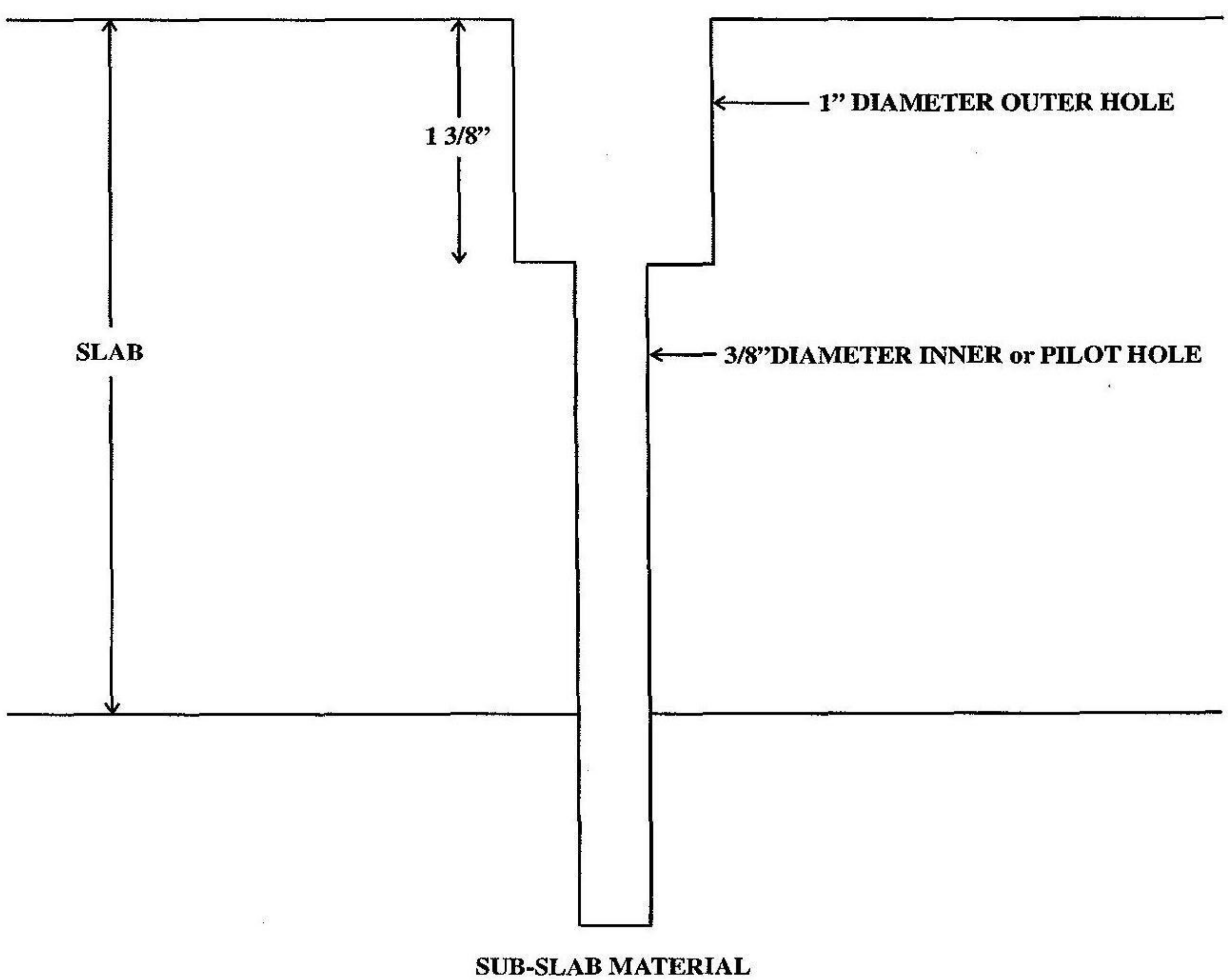


FIGURE 4

SOIL GAS PROBE INSTALLED

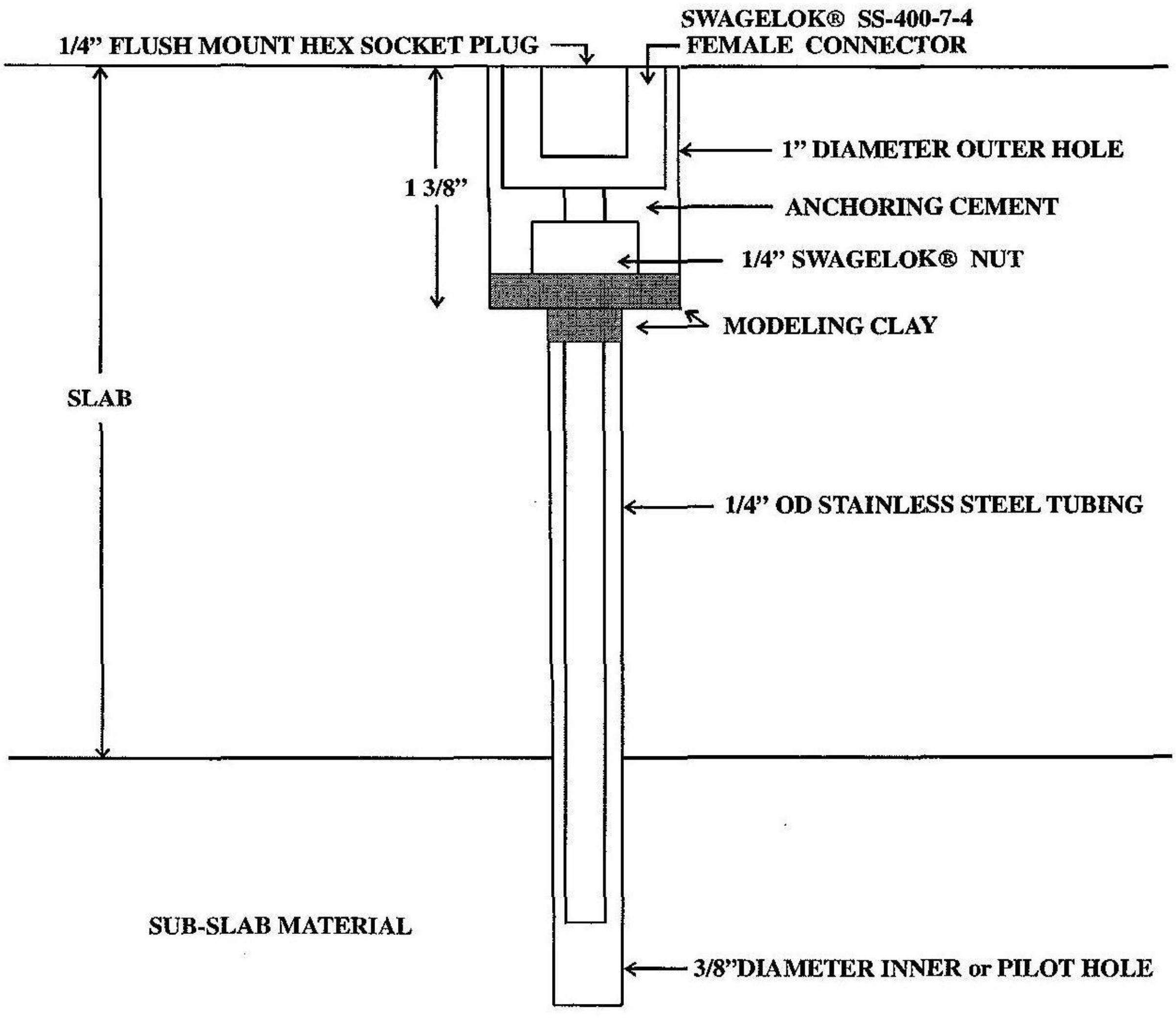


FIGURE 5
SOIL GAS PROBE PREPARED FOR SAMPLING

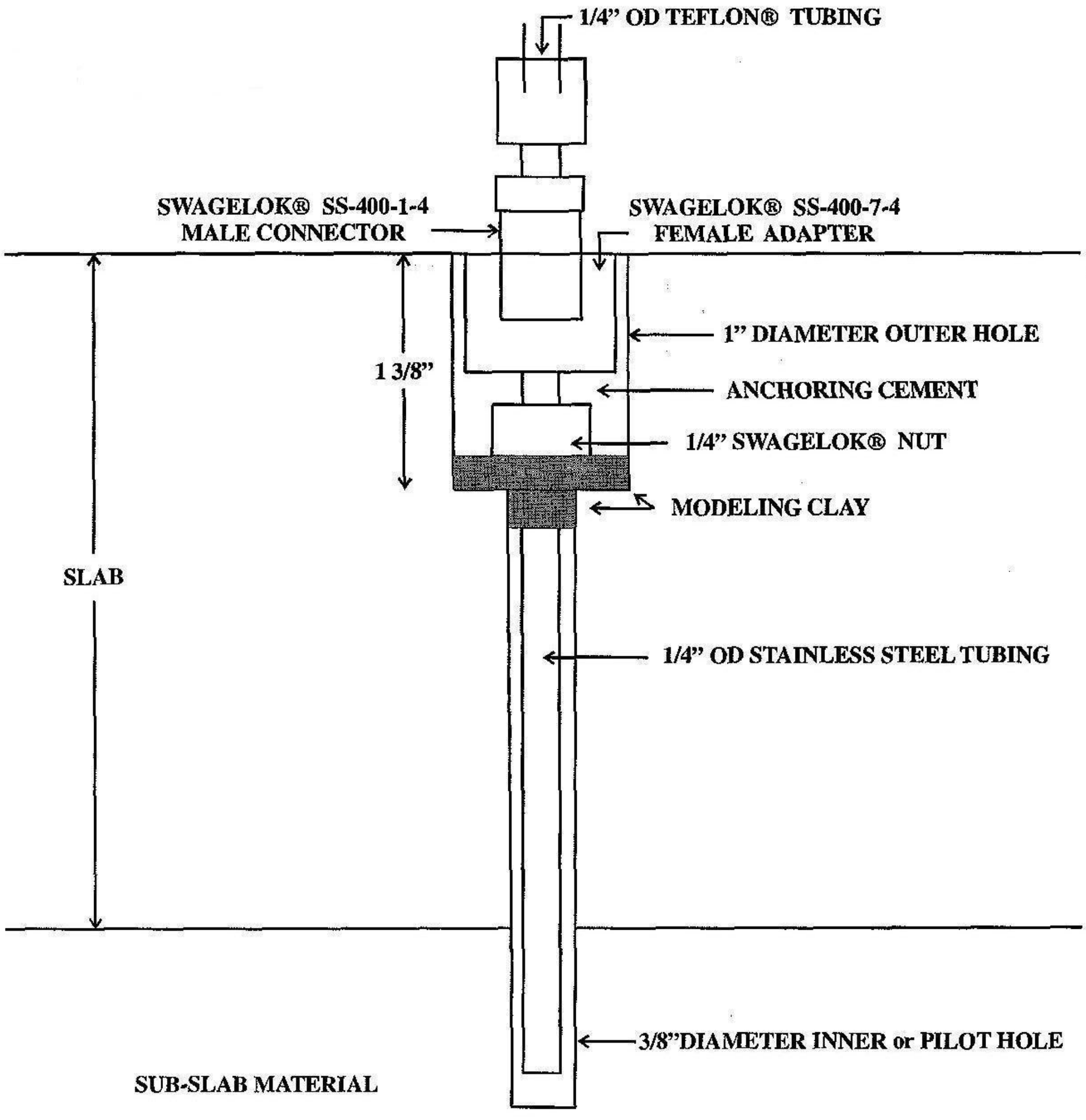


FIGURE 6
SOIL GAS PROBE PREPARED FOR SAMPLING